

Syracuse University

SURFACE

Architecture Thesis Prep

School of Architecture Dissertations and
Theses

Fall 2012

RE-THINKING THE GREEN BELT: SUSTAINABILITY AND DEVELOPMENT IN GROWING CITIES

Maria Saavedra
Syracuse University

Follow this and additional works at: https://surface.syr.edu/architecture_tpreps



Part of the [Landscape Architecture Commons](#)

Recommended Citation

Saavedra, Maria, "RE-THINKING THE GREEN BELT: SUSTAINABILITY AND DEVELOPMENT IN GROWING CITIES" (2012). *Architecture Thesis Prep*. 201.
https://surface.syr.edu/architecture_tpreps/201

This Thesis Prep is brought to you for free and open access by the School of Architecture Dissertations and Theses at SURFACE. It has been accepted for inclusion in Architecture Thesis Prep by an authorized administrator of SURFACE. For more information, please contact surface@syr.edu.

Maria Ines Saavedra

Thesis Prep Book

Fall 2012

SYRACUSE SCHOOL OF ARCHITECTURE

Thesis Advisors:

Rogert Hubeli and Yutaka Sho

RE-THINKING THE GREEN BELT:

SUSTAINABILITY AND DEVELOPMENT IN GROWING CITIES

“Green is undeniably good. After an epoch of individualism, the Green Dream has brought back a collective agenda. Thanks to Green, urbanism is not dead after all. But there’s also a lot of suspicion about Green. Not everyone fighting for Green may be doing it for the right reasons, or with the right information. Sometimes Green is abused. Greenwashing has become the state-of-the-art marketing tool. Architects use bio-mimicry to camouflage their designs. New green laws are not financially backed up yet and therefore absorb budgets for other, spatial qualities. Who can one trust? Are some things wrong with Green...?”

Winy Maas



CONTENTS

0. INTRODUCTION

1. LANDSCAPE + URBANISM

- 2.1 What is Landscape Urbanism?
- 2.2 What is the role of Green Belts in growing cities?
- 2.3 Why don't we create another Green Belt in Santa Cruz?

2. SANTA CRUZ, BOLIVIA

- 3.1 What caused development in Santa Cruz?
- 3.2 Why did development increase so much in the last 10 years?
- 3.3 What are the consequences of the fast developments in Santa Cruz?
- 3.4 What is the impact of the Green Belt on development?
- 3.5 What is the impact of development on the Green Belt?
- 3.6 What are the ecologies affected?

3. PIRAI RIVER

- 4.1 What is the relationship between the Green Belt and the River?
- 4.2 Quality of the water
- 4.3 Topography
- 4.4 Current flooding infrastructures

4. RE-THINKING THE GREEN BELT

- 5.1 How can the Green Belt be re-thought in order to adapt to the fast developments of the city?
- 5.2 How can the Green Belt be used without getting harmed?
- 5.3 How can infrastructure help the environment instead of harming it?

5. PROPOSAL

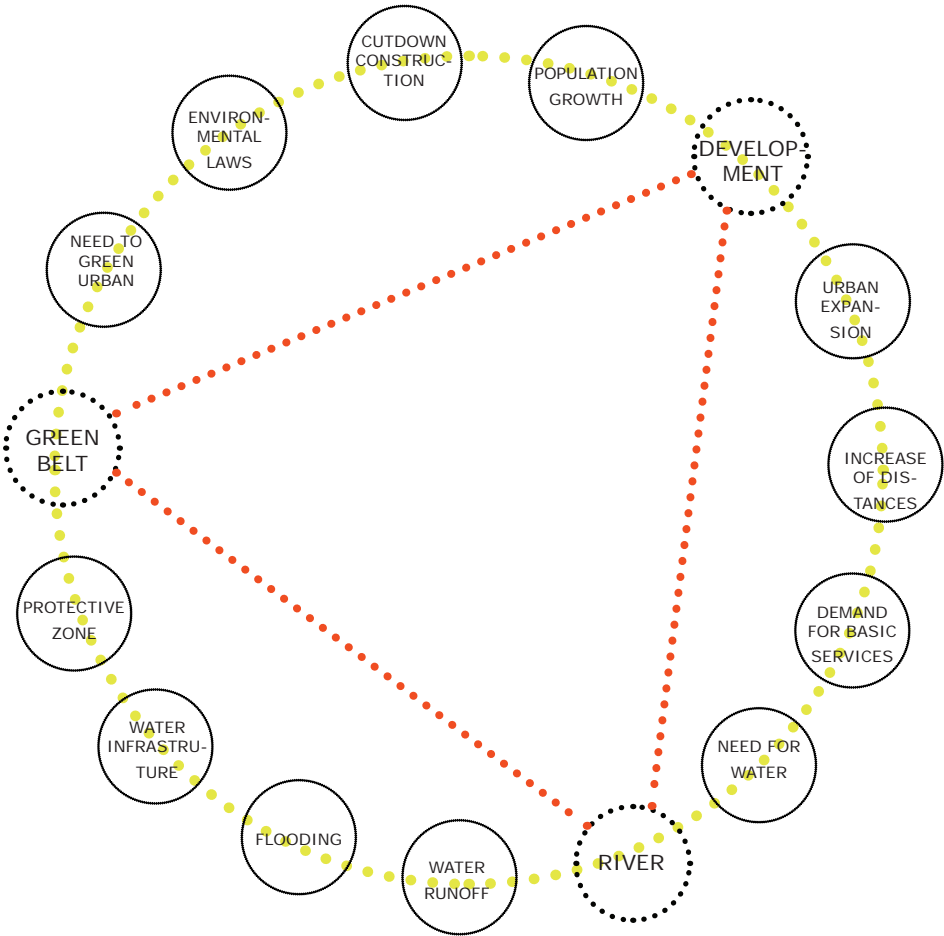
- 6.1 Analysis
- 6.2 The Site
- 6.3 What can be developed on the site?
- 6.4 How can it be inhabited?

6. BIBLIOGRAPHY

INTRODUCTION

Green architecture and urbanism are getting almost universal attention, which they deserve. The incorporation of Green Belts as an urban tool has helped stop sprawl and protect farmland around cities. But what happens when the pressure for growth is so big that it surpasses the boundaries of the Green Belt? In Santa Cruz, Bolivia, development pressures have resulted in expansion of the city beyond the Green Belt, with a second city center developing on the city's hinterlands. This has caused major deforestation and land degradation, challenging the Green Belt's original function: to protect the city from flooding. Instead of stopping sprawl, the Green Belt has pushed development even further away, threatening the functionality of the city. This project will explore how the Green Belt can be re-thought as an opportunity to integrate the natural landscape and built environment in order to sustainably develop it. By acting as a catalyst between the two city centers, the Green Belt would encourage inhabitation along with preservation. The introduction of new infrastructures that adapt to the fast developments of the city and control water floods would encourage urban society to reconnect with the water and learn from it.

Current components of Santa Cruz: Series of events create a never-ending cycle that created an unsustainable development of the city. The integration of the River, the Green Belt and Development should be reconsidered .



CONTENTION

Everybody’s talking about Green these days; sustainable architecture and urbanism are getting almost universal attention. And they deserve it. Thanks to landscape, the abandoned postindustrial centers have been revitalized and growing cities have set up parameters to control their urban expansion. In growing cities, Green Belts have been incorporated as an urban tool that stop sprawl and protect farmland. By establishing a boundary for development, Green Belts encourage the densification of cities, which start to develop vertically rather than horizontally. But, what happens if the city doesn’t remain inside the boundaries of the Green Belt and keeps expanding beyond it?

This is the case in Santa Cruz, Bolivia. Santa Cruz’s Green Belt has become obsolete because instead of containing sprawl it’s pushing it further out. I think that the Green Belt’s inability to adapt to the fast developments of the city has negatively affected the city’s urban expansion. By pushing development away from the river edge with the aim of maintaining it intact, the Green Belt not only increased distances within the urban footprint, but also separated the city from the water. As a reaction, development pushed back on the Green Belt, creating a new city center on the city’s hinterlands. This has created a tension between development and the Green Belt, which presents them as separate entities that threaten the existence of one another. This project will re-think the Green Belt in order to integrate development and nature. By creating a new infrastructure that incentives inhabitation on the site and controls water floods, civilization will integrate with nature and protect it.

As mentioned above, Green Belts act as boundaries that control urban expansion with the aim of protecting the ecologies around it. However, I may argue that isolating the natural and the man-made isn’t necessarily the best way to achieve sustainable development. I think that Green Belts should evolve along with cities. This re-conceptualization of the Green Belt would challenge the conventional notion of ‘Green’ and ‘ecological’ by encouraging its inhabitation. Terms such as ‘Green’ or ‘Eco-friendly’ have started to become part of our lexicons. However, very few persons actually know what these terms stand for. I agree with Winy Maas, who states that Green has been so abused, that it has become a trend.¹ This is not only manipulative, but also dangerous for the environment. Green marketing sells a misconception about nature, and therefore there is a tendency to think that if things look or feel like nature, they are sustainable and good. However, it is important to highlight that sustainability is not the same as nature. Therefore I believe that not every green space is sustainable and that following the Nachhaltigkeitsprinzip of eliminating civilization in order to save nature is not the right method to improve the environment.

It is time to stop thinking of the Green Belt as a physical and moral barrier for development. The Green Belt and the city should support each other instead of stopping each other. Using an interdisciplinary approach, the physical expression of Green Belts during developing process would be re-evaluated. By using infrastructure in order to improve the function of nature, and nature in order to improve the experience of infrastructure, a stronger connection between the natural and the man-made would be established.

The first part of this dissertation will analyze the impact of the Water Front on the morphology of the urban fabric. Santa Cruz started to bloom in the 1950’s after the inclusion of a new highway that connected the East and the West ends of the country. Along with that development, came the introduction of the city’s new master plan. This new plan organizes the city with series of concentric rings that use the historical grid as the city center. However, this plan couldn’t keep up with the fast developments of the city and these rings started to break as they met the major physical barrier for expansion: the River. In 1983, the river flooded. This event caused the loss of 900 people and resulted in the high cost of damages in infrastructure.² As a response, the Green Belt was developed in order to create a barrier between the city and the river. The Green Belt was envisioned as a cushion area that would prevent the river from flooding. In this area, forestation is used as a defense against water and private construction is prohibited. However, this method has proved inefficiency by the constant flooding of the area due to land degradation and deforestation.

In the second phase I will study methods that allow the ecological protection, and yet promote development. Lots of attention is given in the infrastructural systems that improve the ecology during flood. I will look into the different typologies of flooding structures and re-think them in order to create an architectural approach that allows a spatial sequence that leads to the inhabitation of the Green Belt. A close study of topography and its relationship to water floods will help to identify location and massing of these infrastructures. The aim is to integrate water, nature and development, using landscape infrastructure and nature as tools to provide both structural support and flexibility in rapidly transforming condition of a growing city.

One of the major goals of this research is to study the relationship between nature and technology as urban generators. I agree with Lisa Tilder and Beth Bostein, who state that instead of using architectural technology to return nature to some impossible, pre-human pristine state, we should consider fully employing the power of architecture to produce new forms of nature.³ Instead of thinking about the River’s edge as a natural and physical barrier between the water and the city, we should consider it as an opportunity to challenge the image of nature, exploring how it limits or furthers our social desires. A reconceptualization of the River’s edge will help to both establish a more specific control over flooding and create new social spaces that enrich the urban fabric and strive for a sustainable development. This vital realm of the city shouldn’t be ignored during developing process, however, it should be considered a priority equal to that of create the incorporation of new architecture and infrastructure, in order to establish a city that serves all of its inhabitants- both the current residents and those still to come.⁴

1. Maas , Winy, Ulf Hackauf, and Pirjo Haikola. Green Dream. (Amsterdam: NAI Publishers, 2010.), 6-180.

2. Fernandez De Cordova, Martin. Santa Cruz De La Sierra, Bolivia. (Wordpress, 29 Sept. 2012.), 1-7. <<http://martinfdc.wordpress.com/>

3. Lisa Tilder, and Beth Blostein a Design Ecologies. Essays on the Nature of Design. (New York: Princeton Architectural Press), 63-75.

4. Marc Angelil , and Hebel Dirk , Transformation strategies for urban territories in the 21st Century. (Berlin: Birkhauser Verlag AG, 2010), 53-65.

CITY AS AN EGG

How cities grow has changed over the years, resulting in the development of new urban typologies. Cities evolve in relation to their political and economic imperative, which influence the formal organization of the urban print. The form of the city responds to each era and to the revolutions that come with them. Cedric Prises describes the different city forms by comparing them with the different representations of the egg. The Boiled egg represents the ancient city, which was organized around a center. The city was surrounded by a wall, which was meant to protect it from military aggression. This isolated cities from each other and kept governance local. The modern industrial revolution turned the boiled egg into a fried egg. It allowed the city to extend beyond the physical boundaries of the city center and increase the urban footprint. The industrial city was designed around cars and mass-production lines, which became the most important clients of this new city typology. The Post Industrial City is represented by the scrambled egg, which moves away from the centralized organization and dissolves itself into the landscape. The Post Industrial City develops multiple miniature centers in order to create a network within the urban footprint.¹ Santa Cruz, Bolivia, is a special case because it presents all three city typologies in one. Even though the layering of the different city forms suggests a continuous evolution, the paste in which it evolved caused a collage of the three forms at once. Instead of allowing the city to transform and adapt to the new typologies, it juxtaposed the new models on top of the old ones, resulting in

in the segregation of the different zones. Due to the fast paste of development, the city hasn't been able to catch up with the original concentric organization and created an explosive and uncontrolled growth. As the rings lose their gathering force by not being able to keep up with the fast population growth, uneven infrastructural conditions occur. Towards the perimeter, infrastructure is very poor, if not absent at all. This has resulted in the origination of left over spaces. These spaces not only are consequences of the explosive growth, but they are also participants of growth that don't contribute to the development of a sustainable city. One example of these leftover spaces is the green Belt. The Green Belt was originated as an ecological protective zone that served as a cushion for flooding. However, as the city started to evolve, the Green Belt started to lose its original purpose. During developing process of the city, the Green Belt acted as a physical barrier for expansion that pushed development to only one side of the city. However, development pushed so hard that started to cross the boundaries of the Green Belt. As a new city center arises on the opposite side of the river, a necessity to 'jump' the Green Belt was created, which resulted in major deforestations on the Green Belt. This deforestations harmed the ground, increasing flooding, thus challenging the Green Belt's function and making it obsolete. The questions is how can the Green Belt be rethought in order to adapt the fast developments of the city while keeping its ecologies and protects the city from flooding.



Figure 0.1 showing the different typologies of cities.

1. Graham Shane, "The Emergence of Landscape" *The Landscape Urbanism Reader* (New York: Princeton Architectural Press, 2006), 55-68.



LANDSCAPE + URBANISM

- What is landscape urbanism?
- What is the Role of Green Belts in developing cities?
- Why don't we create another Green Belt in Santa Cruz?

WHAT IS LANDSCAPE URBANISM?

Landscape Urbanism arises as a design strategy that highlights the leftover void spaces of the post- industrial city and turns them into potential commons. The post-modern decentralized city has started to blur the boundaries between the urban footprint and the surrounding landscape, and regions have started to view the qualities of their landscape not only as marketable entities, but also as reserves of public space.² Through landscape the industrial context is linked to a pre-modern ecological era that sees nature as the primary medium of city making. Topography, groundcover, light, trees and watersheds become important design tools that allow the creation of flexible spaces. However it is important to highlight that the goal of landscape is not only scenic, but also infrastructural. The aim is to create settings for programmed and

unprogrammed activities that are adaptable to various circumstances. These flexible open spaces will create performative social patterns that would be colonized by different groups of people in multiple ways.³ Even though landscape urbanism arose as a new way of urbanism for post-industrial shrinking cities, it has also played an important role in growing cities. However, it is important to highlight that the way it performs in both scenarios is completely different. While in the post industrial city landscape urbanism focuses on revitalizing the abandoned industrial centers, in growing cities it acts as a method that helps control urban expansion. Through landscape, the boundaries for the perimeter of the urban footprint have been determined.



Figure 1.1

2. Kelly Shannon, "From Theory to Resistance: Landscape Urbanism in Europe" *The Landscape Urbanism Reader* (New York: Princeton Architectural Press, 2006), 141-161.

3. Graham Shane, "The Emergence of Landscape" *The Landscape Urbanism Reader* (New York: Princeton Architectural Press, 2006), 55-68.

WHAT IS THE ROLE OF GREEN BELTS IN GROWING CITIES?

Green Belts are urban growth boundaries that have the aim of stopping sprawl and protecting farmland around cities. One of Green Belt's main functions is to increase density in order to create a more urban atmosphere. By limiting the horizontal growth of an urban footprint, the city is forced to develop vertically rather than horizontally. This helps the revitalization of the city center as well as raised the value of land within the established perimeter.⁴ Also, by acting as the line that separates nature and development, the Green Belt aims to protect the ecologies existing around cities. However, I may argue that this sharp boundary isn't necessary the best solution neither for the city nor for nature. Nature and the city are often seen as antonyms and are presented isolated from each other. This means that where there is nature, development can't occur; and where there is development,

nature has already gone away. Development in the form of gray infrastructure is seen as a threat for cities. It is the main cause for the pollution of air, soil and waterways. At the same time, nature presents itself as the physical and moral boundary for development. This mainly happens because of the lack of dialogue between the natural and the man-made. But, what would happen if we combine them in order to support each other instead of stopping each other? What if infrastructure improves nature and nature improves infrastructure? I believe that nature has the ability to improve the experience of infrastructure, and that infrastructure has the ability to improve the function of nature. By using nature and development as the main design tools, an economically, socially and environmentally sustainable city would be achieved.

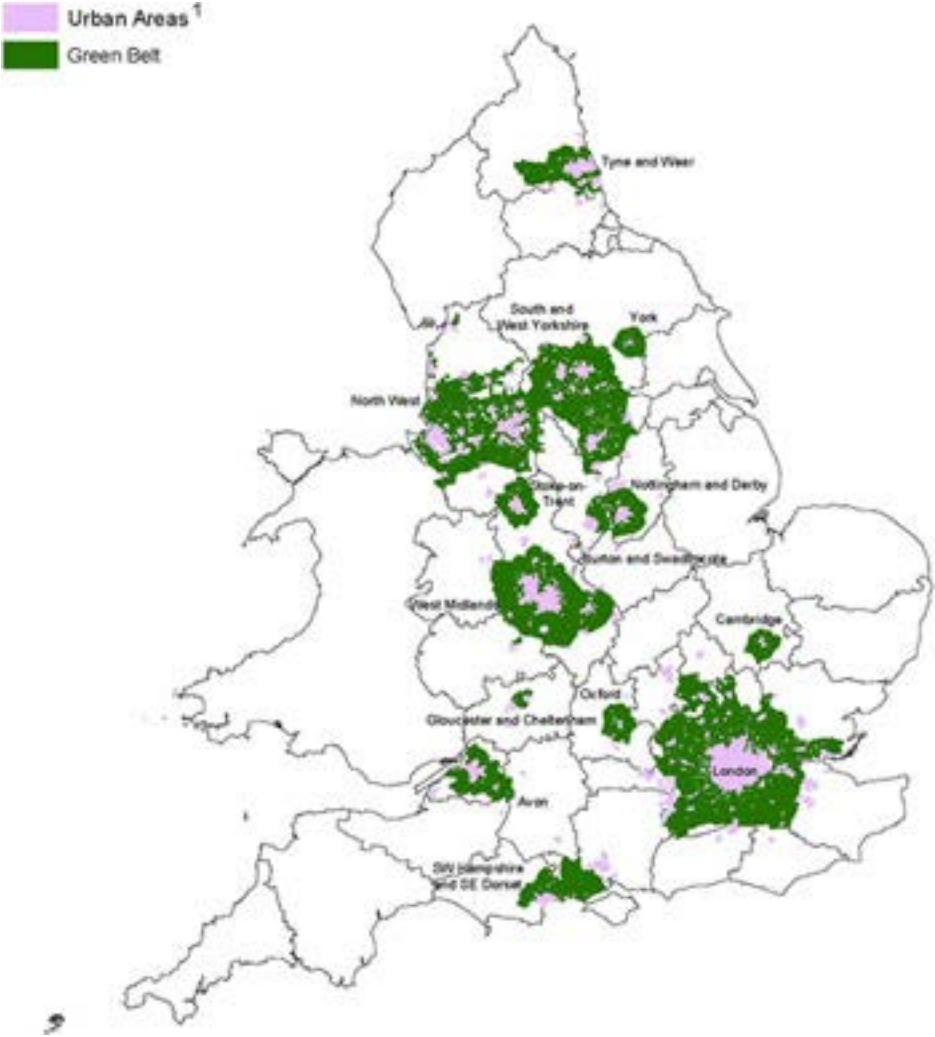


Figure 1.2 Showing the use of Green Belts as growth boundaries for cities in Britain.

4. Sitko Nicki
"Urban Growth
Boundaries: Economic
Development Tool or
unwanted Interfer-
ence?"
(April, 21, 2005), 1-7.

PRECEDENT: TORONTO'S GREEN BELT

Toronto, Ontario is an example where the incorporation of the Green Belt has caused a positive impact in the urbanization of the city. In Toronto, the decentralization of economic activity forced to city to expand into the surrounding suburbs. In order to prevent development outside the urban area, industry, retail and housing were forced to be built on vacant or underused parcels within the established boundary.⁵

Unlike in Santa Cruz, where the Green Belt functions as a force that pushes development away from the water; in Toronto the Green Belt functions as a force that reinforces the connection between the city and the water. Also, by incorporating hamlets and villages within the Green Belt, a direct flow between the city of Toronto and the surrounding nature is created.

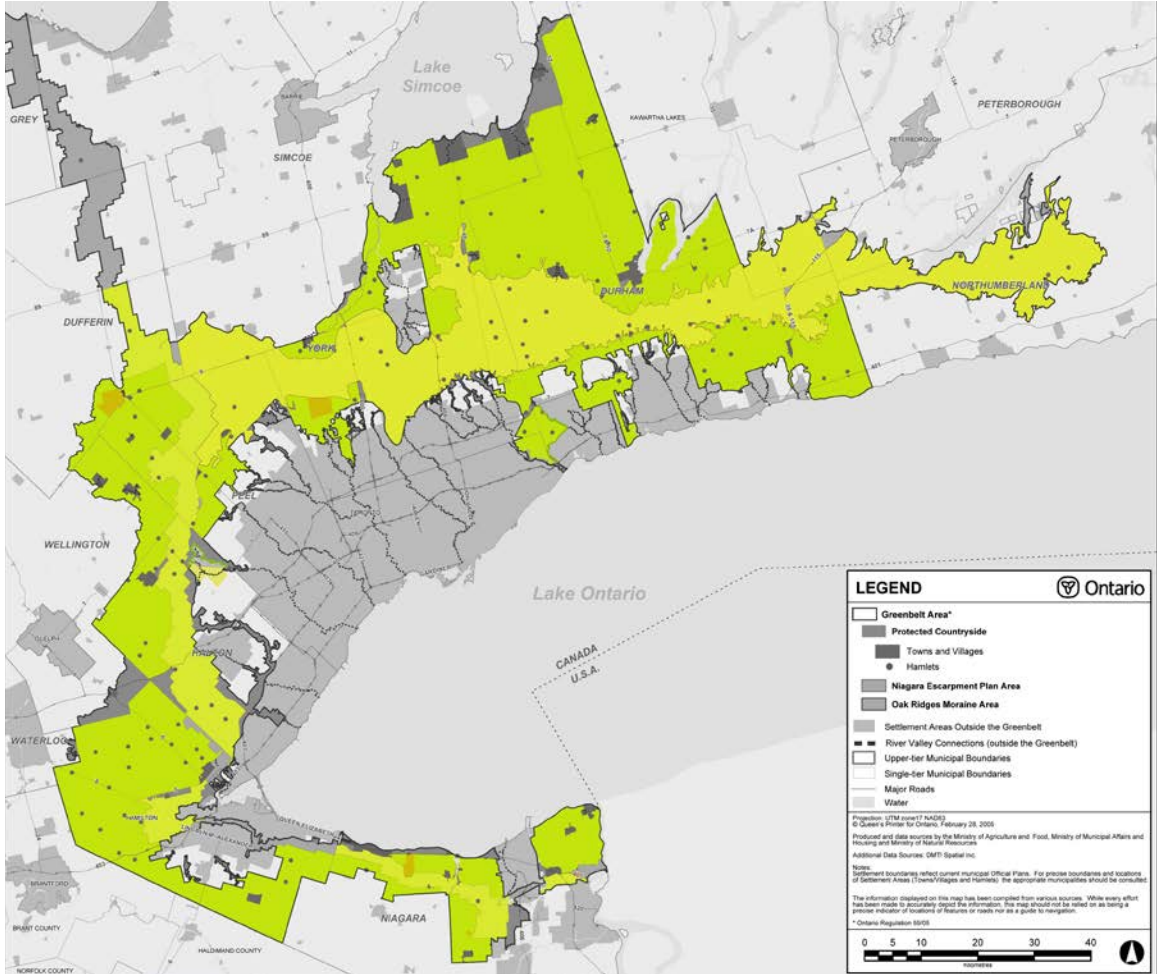


Figure 1.3 Showing Toronto's Green Belt Plan.



Figure 1.4 Showing Toronto's footprint.

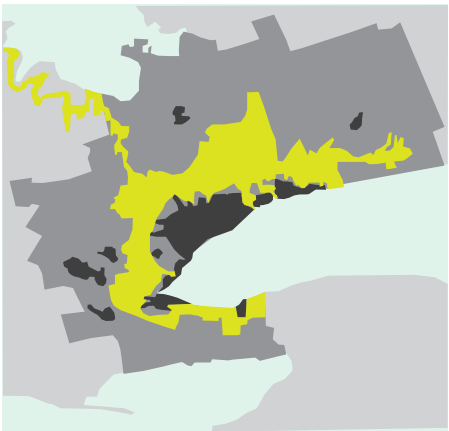


Figure 1.5 Showing Green Belt and footprint.



Figure 1.6The Green Belt pushes the city to the water.



Figure 1.7 Showing Santa Cruz's footprint.



Figure 1.8 Showing Green Belt and footprint.

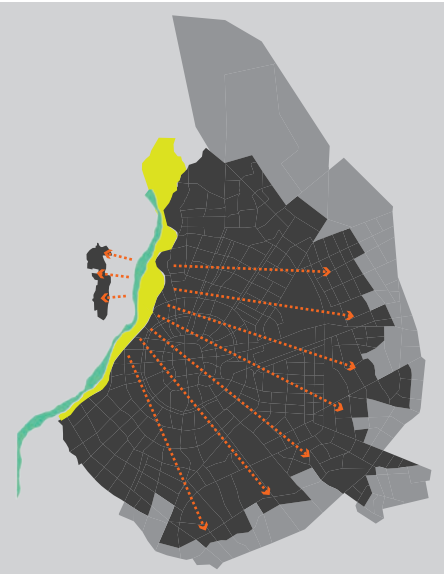


Figure 1.9The Green Belt pushes the city away from the water.

5. Sitko Nicki "Urban Growth Boundaries: Economic Development Tool or unwanted Interference?" (April, 21, 2005), 1-7.

PRECEDENT: FORESTICITY

Foresticity is a project that uses reforestation as an urban design strategy for Ethiopia. New settlement provides benefits not only for the inhabitants, but also for the entire ecological system.

When Reforestation occurs in conjunction with the expansion or generation of cities, the growth of those cities acts as a tool for forest generation. Ultimately cities become a means to spread forests throughout the country.



5. Sitko Nicki
"Urban Growth
Boundaries: Economic
Development Tool or
unwanted Interfer-
ence?"
(April, 21, 2005), 1-7.

WHY DON'T WE CREATE ANOTHER GREEN BELT IN SANTA CRUZ?

The Role of Green Belts is to act as boundaries for the horizontal expansion of the city. By establishing a physical limit for horizontal development, the city is forced to expand vertically, creating a denser and higher urban mass. The implementation of Green Belts in fast growing cities has helped curbing urban sprawl and protecting green areas. Cities like Portland, Toronto, Seattle, Copenhagen and Vancouver have implemented this urban strategy in order to promote the economic development of existing urban voids as well as enhance the conservation of farmlands on the perimeter. But what happens if the city doesn't remain inside the boundaries of the Green Belt and keeps expanding beyond it? This is the case in Santa

Cruz. In Santa Cruz, the current Green Belt has become obsolete because it isn't stopping development; it's just pushing it further away. By creating an adjacent center next to the Green Belt, people have started to create plans to 'jump' the Green Belt in order to get to the next center. This not only has challenged the function of the Green Belt, but has also harmed its ecology by causing deforestation and erosion in the ground. Therefore we can say that before creating another Green Belt we have to solve the problems of the current Green Belt. If we create another Green Belt now, we would be duplicating the Problem. Therefore the first step to take is to re-think the Green-Belt in order to adapt it to the current conditions of the city.

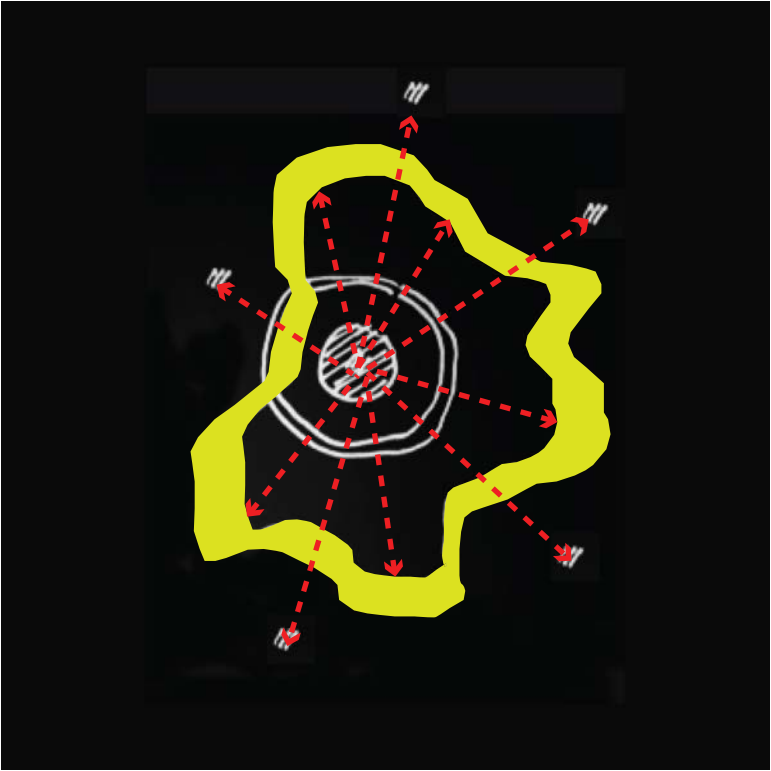


Figure 1.10 - As the city evolves into a Post-Modern city, centers beyond the Green Belt would be created, and development would be pushed further away.



SANTA CRUZ, BOLIVIA

-Introduction

-What caused development in Santa Cruz?

-Why did development increase so much in the last 10 years?

-What are the consequences of this fast developments?

- What is the role of the River?

-What is the impact of the Green Belt in the formation of the urban footprint?

-What is the impact of Development on the Green Belt?

SANTA CRUZ - INTRODUCTION

Santa Cruz is the largest city in Bolivia. It is the economical center of the country, and contributes with more of 80% of the national agricultural production. Its tropical climate, which has an average annual temperature of 23 C (74 F) and its fertile land support agriculture and cattle, which are 2 of the major economic activities in the region. Some industries that have also contributed to the city's economic expansion in the last 10 years are oil, gas, iron, forestry companies, and construction. In the last 10 years Santa Cruz has experienced an explosive growth, which has turned it into the 14th fastest growing city in the world.⁶

Even though the city began developing very slowly, since 1960's it has experienced a non-stopping development phase that keeps increasing. Since the inauguration of the La Paz - Santa Cruz highway in the 1960's, series of economic events pushed development, which resulted in the uncontrolled expansion of the urban footprint. Due to the fast developments of the city the original centrifugal organization of the urban footprint got lost. Because infrastructure couldn't keep up with the urban expansion, an explosive and informal growth extended beyond the organizational rings and started to expand the perimeter of the city. However, one edge of the urban form stood still and acted as a barrier for development. The green Belt, which was a created as a protective zone that acted as a response to the 1983's flood, is the only physical barrier that stops the city from growing to the West. It acts as a pressure that pushes development to only one side of the city. This not only has separated the city from the river, but has also challenged the sustainability of the city's evolution by increasing distances within the urban footprint.

On the other hand, development has also acted as a pressure that affects the Green Belt negatively. Due to the uncontrolled growth of the city, illegal development has been manifested in different zones of the Green Belt, harming existing ecologies on the site. The city's pressure for further development has started to take over the Green Belt in an unconscious manner, harming the environment and causing erosion on the floor.

6. Gandarilla Suarez, Remberto. "Santa Cruz en los Umbrales del Desarrollo" (1995)



Figure 2.1



Figure 2.2



Figure 2.3



Figure 2.4



Figure 2.5



Figure 2.6



Figure 2.7



Figure 2.7

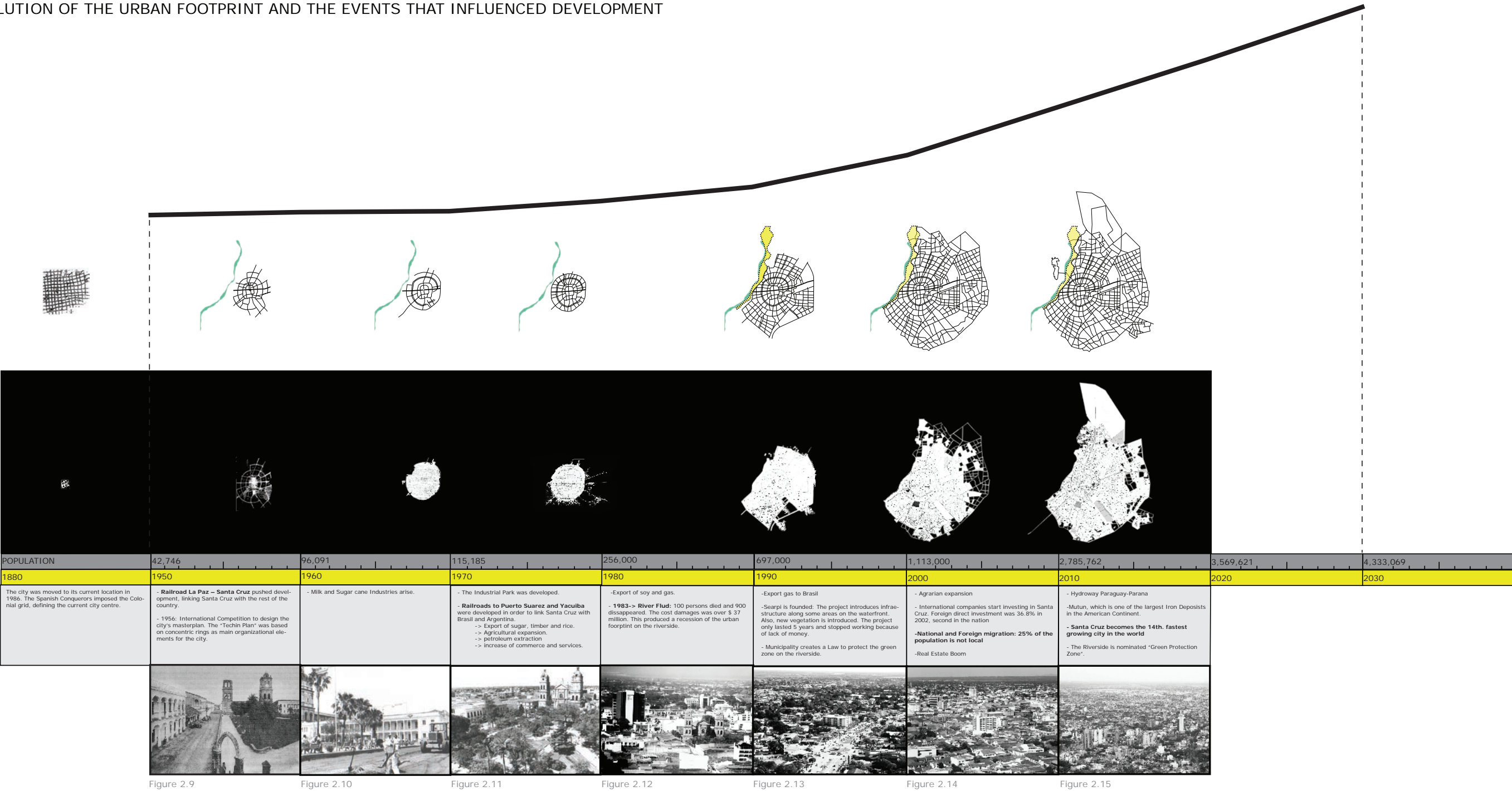


Figure 2.8

WHAT CAUSED DEVELOPMENT IN SANTA CRUZ?

Even though the city began developing very slowly, since 1960's it has experienced a non-stopping development phase that keeps increasing. Since the inauguration of the La Paz - Santa Cruz highway in the 1960's, series of economic events pushed development, which resulted in the explosive expansion of the urban footprint. Some of these economic events are the agricultural expansion, which resulted in the rise of the sugar, rice and milk industries, and the extraction of oil and gas. As the population started to increase, so did the urban footprint, this showing that the expansion of the city was horizontal rather than vertical.

Diagram showing the population increase, the evolution of the urban footprint, the economical causes for development and the change in density over time.



1950

- **1956:** Railroad La Paz - Santa Cruz. The Railroad pushed development in Santa Cruz by linking it with the rest of the country.

-**1956:** International Competition to design the city's Masterplan. The 'Techin Plan' was based on centric rings as the main organizational elements for the city.⁷

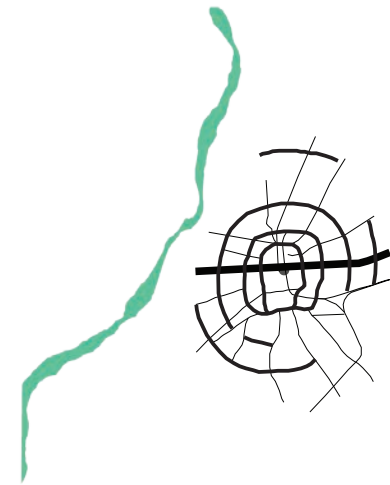


Figure 2.16



Figure 2.17

7. Gandarilla Suarez, Remberto. "Santa Cruz en los Umbrales del Desarrollo" (1995)

1960

- Milk and Sugar Industries arise, developing mostly the northern part of the city.

- Streets around the main Plaza started to get paved.⁸

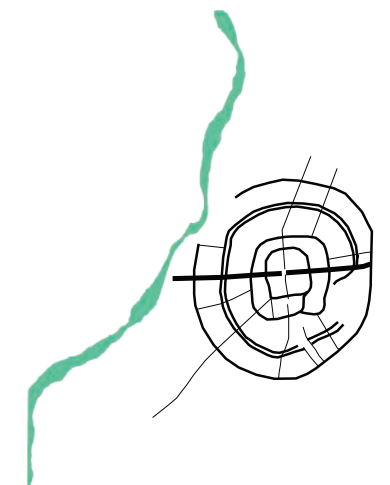


Figure 2.18



Figure 2.19

8. Gandarilla Suarez, Remberto. "Santa Cruz en los Umbrales del Desarrollo" (1995)

1970

- The Industrial Park was developed. - Railroads to Puerto Suarez and Yacuiba were developed in order to link Santa Cruz with Brasil and Argentina.
- Export of sugar, timber and rice.
- Agricultural expansion.
- Petroleum extraction
- Increase of commerce and services.⁹

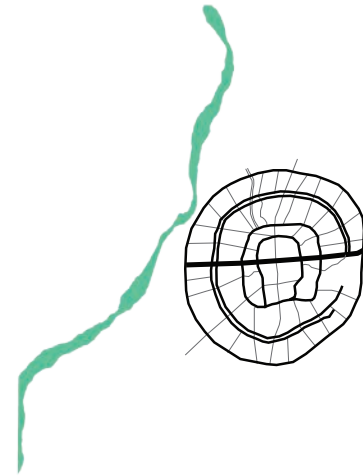


Figure 2.20

9.. Gandarilla Suarez, Remberto. "Santa Cruz en los Umbrales del Desarrollo" (1995)



Figure 2.21

1980

- Export of soy and gas.
- **1983** - River Flood: 100 persons died and 900 dissappeared. The cost damages was over \$ 37 million. This produced a recession of the urban foorptint on the riverside.¹⁰

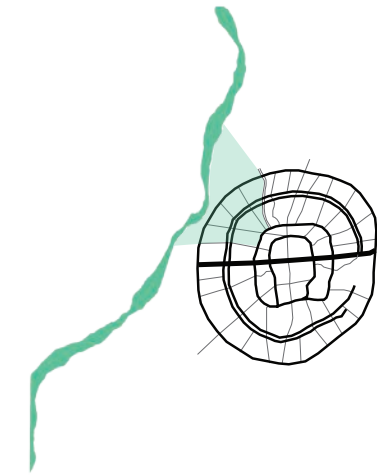


Figure 2.22

10. Gandarilla Suarez, Remberto. "Santa Cruz en los Umbrales del Desarrollo" (1995)



Figure 2.23

1990

- Export Gas to Brazil.

-Searpi, the foundation in charge of protecting the ecologies on the Green Belt, is founded: The project introduces infraestructure along some areas on the waterfront, as well as new vegetation is introduced. This came along with the implementation of new laws that restricted construction on the area.

-Article 13: The Protected area can not be used for any agricultural or forestal purpose. It can only be used for hydroenergetic, recreational, research or educational purposes. The forestal zone, which are considered State's territory, are declared as protective forests. All the private property within the green zone has to be reforested and can be used only for ecological purposes. According to the article 35, 100 metres on each side of the waterfront are considered Protective Zones, because they are considered risky areas for flood or erosion.¹¹

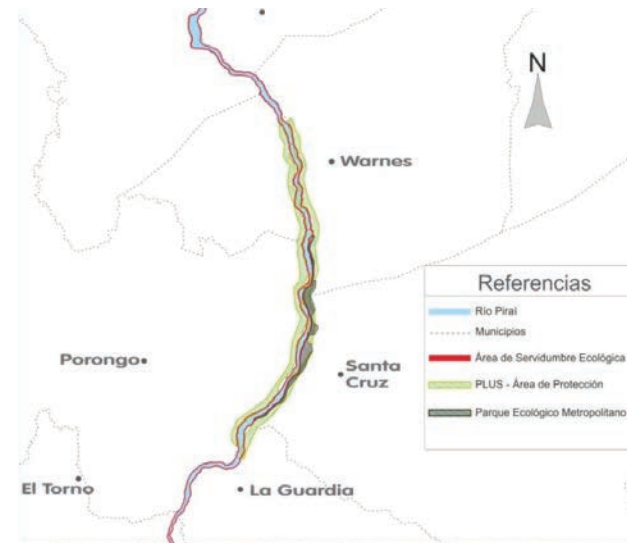


Figure 2.25

11. Searpi. "Cuenca Hidrografica del Rio Pirai" (May,29,2012)

Figure 2.24

2000

- Export Gas to Brazil.

-Searpi, the foundation in charge of protecting the ecologies on the Green Belt, is founded: The project introduces infraestructure along some areas on the waterfront, as well as new vegetation is introduced. This came along with the implementation of new laws that restricted construction on the area.

-Article 13: The Protected area can not be used for any agricultural or forestal purpose. It can only be used for hydroenergetic, recreational, research or educational purposes. The forestal zone, which are considered State's territory, are declared as protective forests. All the private property within the green zone has to be reforested and can be used only for ecological purposes. According to the article 35, 100 metres on each side of the waterfront are considered Protective Zones, because they are considered risky areas for flood or erosion.¹²

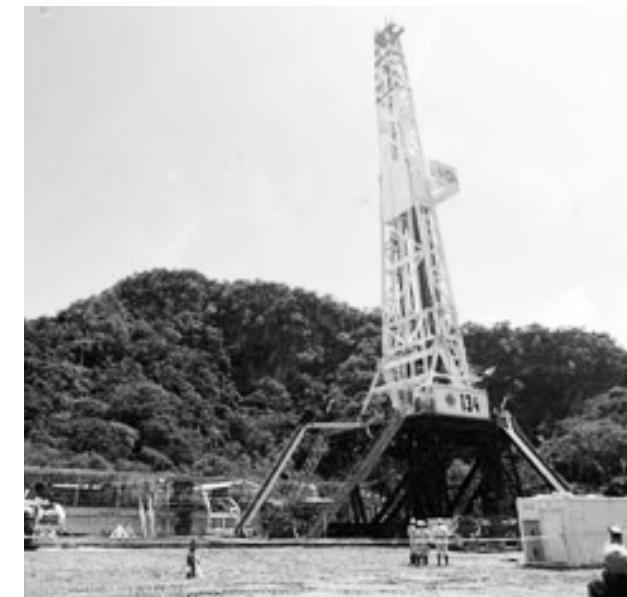
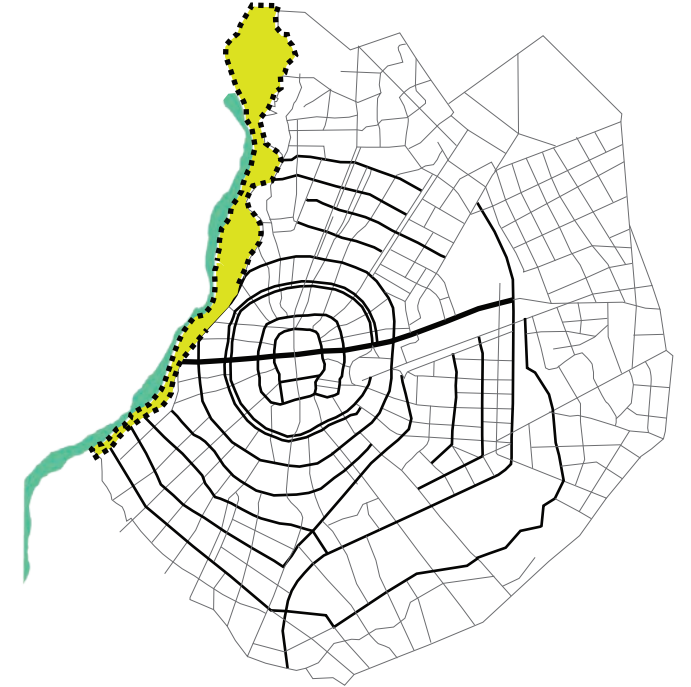


Figure 2.26



Figure 2.27

12. Searpi. "Cuenca Hidrografica del Rio Pirai" (May,29,2012)

2010

- Hydroway Paraguay-Parana
- Mutun, which is one of the largest Iron Deposits in the American Continent.
- Construction Boon
- Santa Cruz becomes the 14th. fastest growing city in the world
- Major deforestations on the “Green Protection Zone”. These are caused by the construction of the Urubó, informal settlements and Waste Water Tank. Major legal problems with authorities.

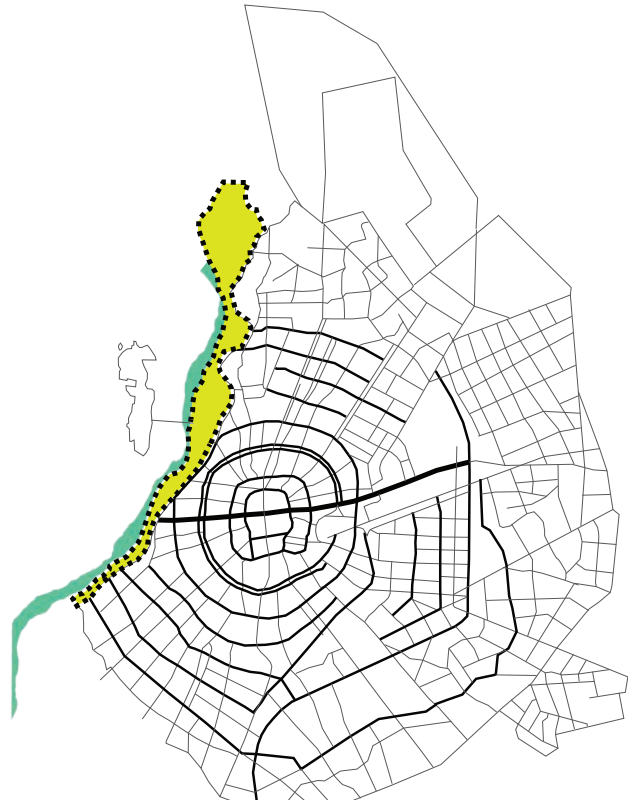


Figure 2.28



Figure 2.29

13. Searpi, "Cuenca Hidrografica del Rio Pirai" (May,29,2012)

2010

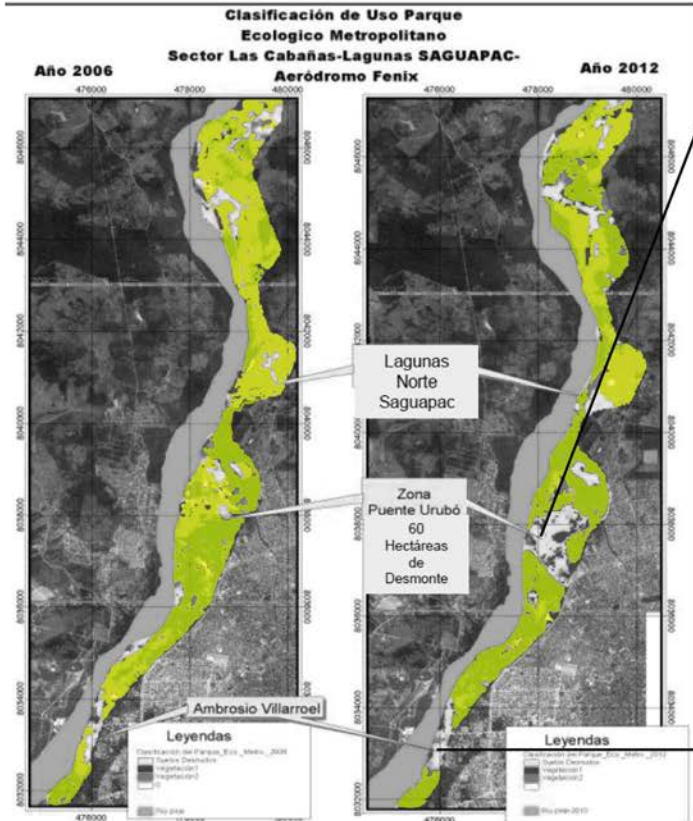


Figure 2.30 - Comparing deforestation on the Green Belt in 2006 vs. 2012.



Figure 2.31 - Bridge to the new developments on the opposite side of the river is the major cause for the increase in deforestation.



Figure 2.32 - Informal Settlements on the river edge are also a major cause for deforestation on the Green Belt.

WHY DID DEVELOPMENT INCREASE SO MUCH DURING THE LAST 10 YEARS?

In the last 10 years Santa Cruz has experienced an explosive growth, which has turned it into the 14th fastest growing city in the world. During the 2000's, international companies started investing in Santa Cruz and created major headquarters that supported the city's growth. In 2002, foreign direct investment was 36.8%, which put Santa Cruz second in the nation in international investment. Some industries that have enhanced international investment in the last 10 years are agriculture, oil, gas, and iron.

Also the growth of the manufacturing industry, such as milk, coffee, canned fruits, cigar, beer, plastic, chemicals, medicines, fertilizers and insecticides has enhanced the further economic development on the city.¹⁴ Due to the large immigration present in the city, both international and national, construction has increased notoriously, mostly in the form of real estate. This has manifested itself in the form of gated communities, high rise apartment buildings and informal settlements.



Figure 2.33 - High rises are getting built on the edge of the Green Belt.

14. Brrun Arril, "Santa Cruz de la Sierra, Bolivia - From a tiny Town to Political Pace-setter" (2011)

1956

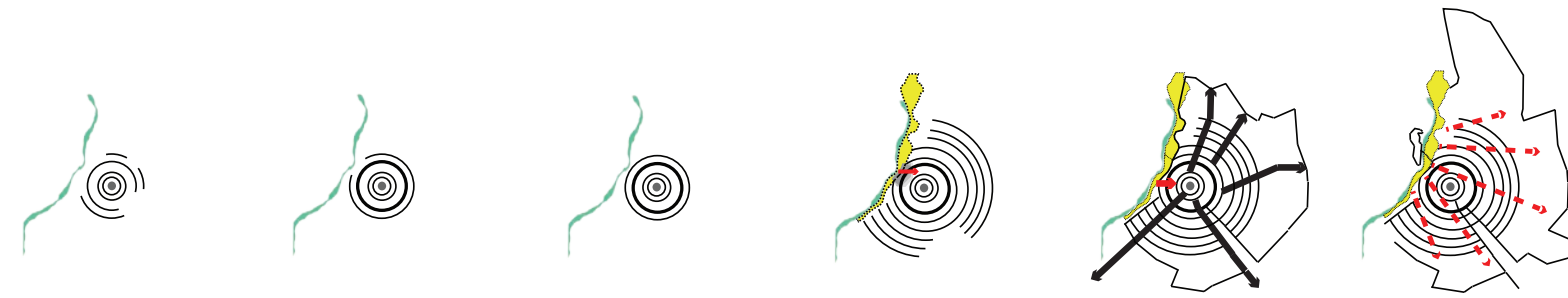
1969

1977

1994

2007

2012



WHAT ARE THE CONSEQUENCES OF THIS FAST DEVELOPMENTS?

Even though the fast pace of development has had a positive impact on the economy of the city, we can see that it hasn't affected positively the evolution of the urban footprint. Due to the fast developments of the city the original centrifugal organization of the urban footprint got lost. Because infrastructure couldn't keep up with the urban expansion, an explosive and informal growth extended beyond the organizational rings and

started to expand the perimeter of the city. These peripheral zones arose without any previous plan, which means that in most of the cases, they don't count with basic infrastructure or services. This has also resulted in a socio-economical segregation of the urban footprint, targeting the central portion of the city for the rich, while pushing the poor to the furthest points from the city center.

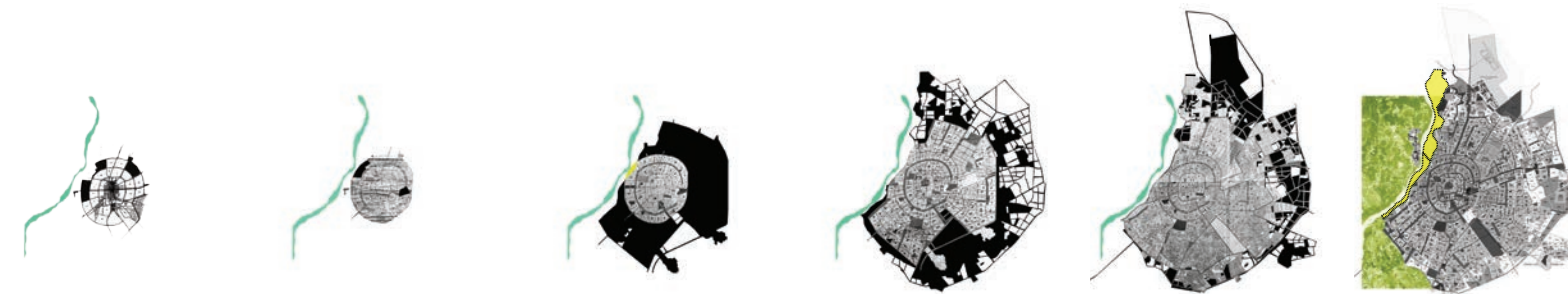
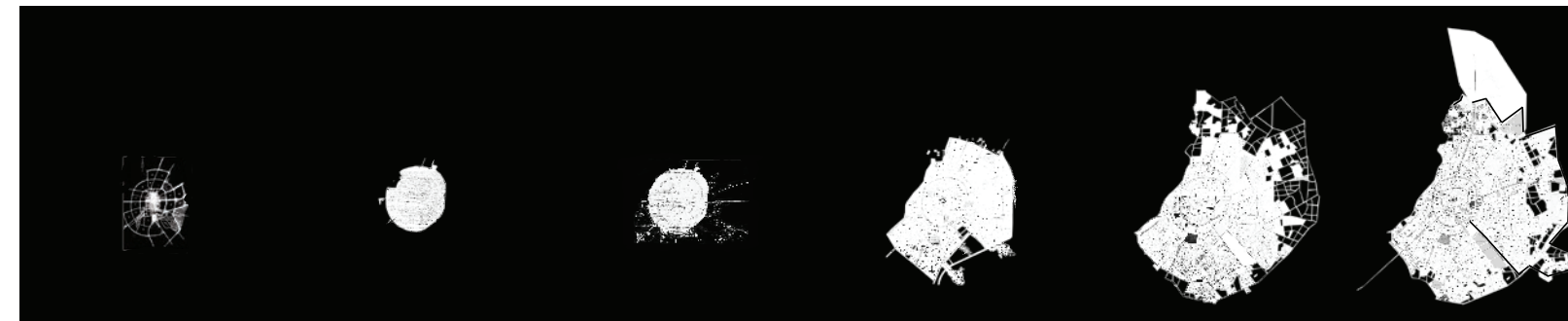
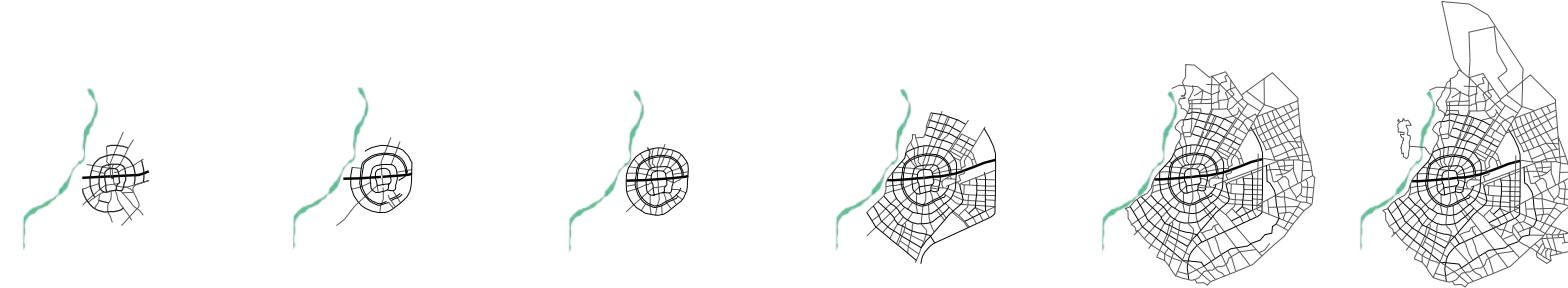


Figure 2.34 Showing the Evolution of the Urban Footprint since 1956.

WHAT IS THE IMPACT OF THE GREEN BELT ON THE FORMATION OF THE URBAN FOOTPRINT?

Even though the Green Belt was created as a Protective Zone that kept the urban footprint from flooding, its impact on the evolution of the urban form has been negative. By acting as the only physical boundary for expansion, the Green Belt caused an explosive growth of only one side of the city. This not only has separated the city from the river, but has also challenged the

sustainability of the city’s evolution by increasing distances within the urban footprint. By creating larger distances within the urban footprint, the costs on infrastructure and reliance on automobile transportation increase. Due to lack of funds, these infrastructures don’t occur immediately and therefore create poor living conditions on the city’s edge.

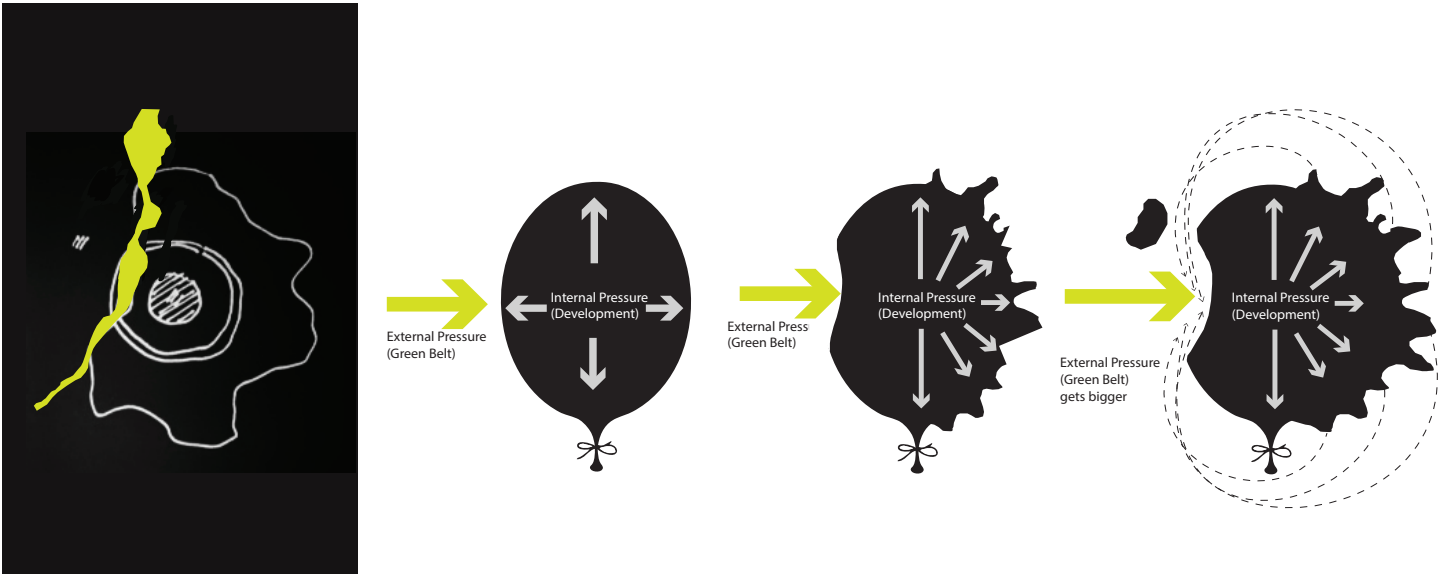


Figure 2.35 - Diagram showing the cycle of pressure and urban growth.

WHAT IS THE IMPACT OF DEVELOPMENT ON THE GREEN BELT?

In the last 10 years, the city expanded so much that it exploded and started to push development back into the Green Belt, corrupting it. The fast developments of the city started to break the Green Belt's boundaries with the aim of inhabiting and going through it. Informal settlements have been originated on the river edge with the aim of expanding the city on the Green Belt. These informal settlements have caused major deforestation on the Green Belt, as well as erosion on the ground. On the other hand, new gated communities on the opposite site of the river have been created as a way to keep expanding the city beyond the Green Belt. This has also

created major deforestation by constructing traffic lanes that go through the Green Belt in order to connect the new developments with the city center. By causing deforestation and erosion on the ground, the new manifestations of development have harmed the existing ecologies on the Green Belt, which were the main protective tools against flooding. This situation challenges the Green Belt's main function: protect the city from flooding. As a result, the Green Belt has the necessity of increasing its size in order to allow more zone for flooding. As we can see, this turns into a never-ending cycle that harms the developing process of the city.

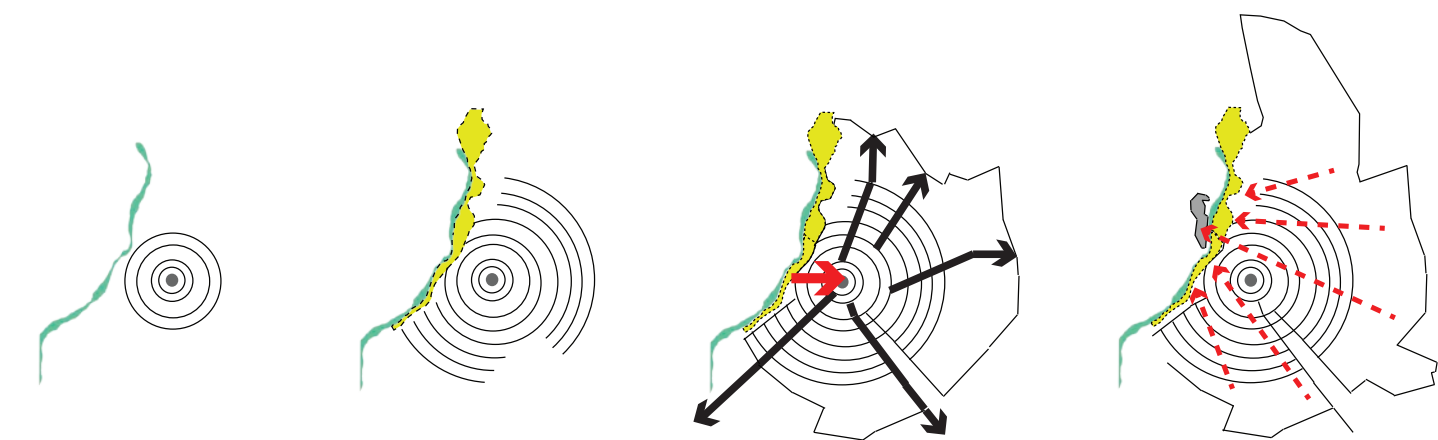


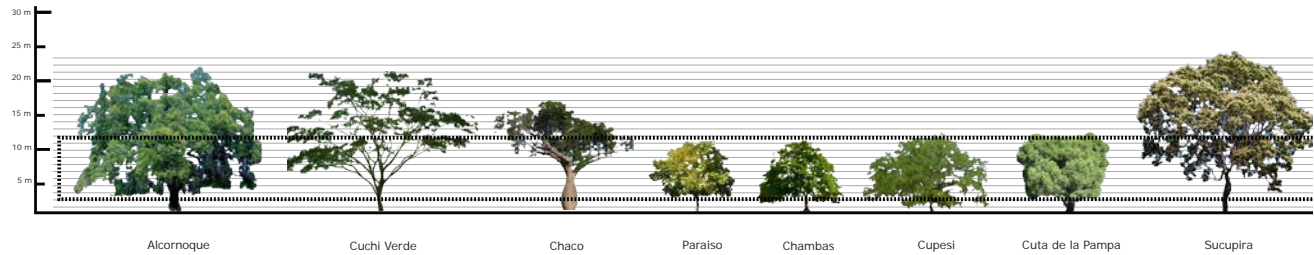
Figure 2.36 - Diagram showing the cycle of pressure of Green Belt on Development and vice-versa.

WHAT ARE THE ECOLOGIES AFFECTED?

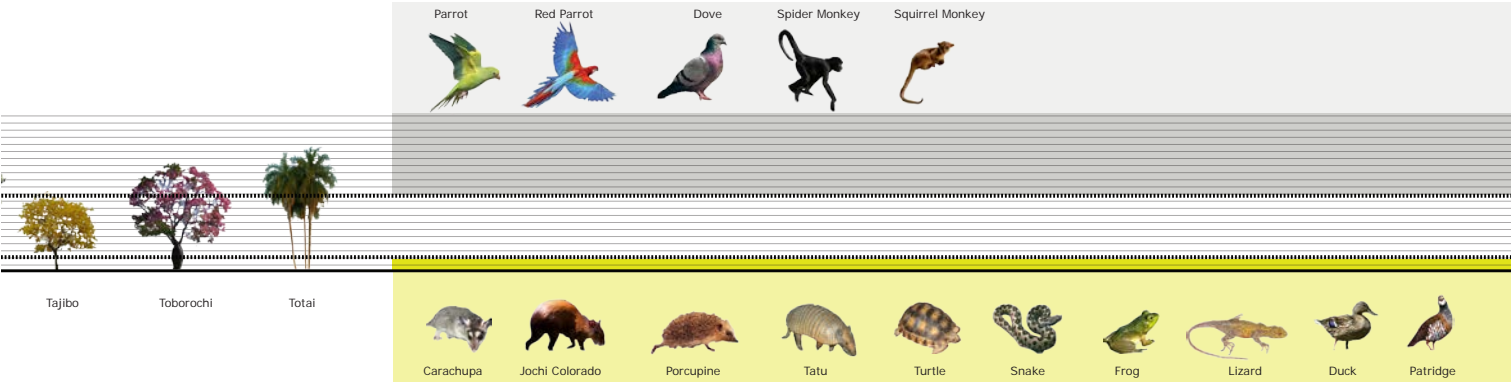
The existing ecologies on the Green Belt are composed of large scale trees that are between 10 meters to 30 meters high. There are 10 different species of amazonic trees and and palms, like Alcornoque tree, Cuchi Verde, Chaco, Paradise, Chambas, Cupesi, Cuta, Sucupira, Tajibo, Toborochi and Totali. The vegetation remains

green all year long due to the constant temperatures and regular precipitation. The animal species on the Green Belt can be divided into 4 different groups, which are: birds, monkeys, reptiles and rodents. The birds and the monkeys inhabit the top of the trees, while the reptiles and the rodents inhabit the ground.¹⁵

PLANT SPECIES



ANIMAL SPECIES



15. Warren Patrizio, "Ordenamiento Ter-ritorial municipal: una experiencia en el Departamento de Santa Cruz, Bolivia" (2000)

Figure 2.37 - Diagram showing vegetation and animal species on the Green Belt.



PIRAI RIVER

-What is the relationship between the River and the Green Belt?

-Ecologies on the Green Belt

-Quality of the Water

-Topography

-Current infrastructures used to stabilize flooding

WHAT IS THE RELATIONSHIP BETWEEN THE RIVER AND THE GREEN BELT?

The Green Belt was originally created as a cushion for flooding. It is meant to protect the city from the rises in water during high precipitations. However, due to deforestation and erosion on the River Edge, the Green Belt hasn't been doing its task. A major flood, which resulted in the death of 2 people on September 19th 2012, proves the lack of efficiency of the current infrastructures on the site.¹⁶

However, instead of working against water, the Green Belt should work as a support for water. The should rehearse not only as a cushion for flooding, but also as zone that uses flood as an opportunity to improve the quality of the water. That way a stronger relationship -both spatial and functional- would be developed between the Green Belt and the River.



Figure 3.1 showing flood on the Green Belt.



Figure 3.2 showing flood in the city.

16. Vesna, Marinkovic, "Jornada del Censo de Poblacion y Vivienda 2012." (2012)

QUALITY OF THE WATER

- The Pirai River is an amazonic River. The Pirai is a braided river and it is wider than deeper, sub divided into several branches. The width goes from 50 to 500 metres, the river basin elevation ranges from 2600 m.a.s.l. to 250 m.a.s.l.

-From La Espejos to Santa Cruz, the river loses its geological control and in some places it is prone to avulsion.-Flooding in Pirai River obeys entirely to flash floods. Pirai River is highly dynamic but it has individual characteristics in each one of its sub regions. The economic boom of this fertile area in an alluvial plain prone to inundation creates high pressure on the authorities to prevent inundation.

-The measurements of the Service of Channelling and Regulation of the River Pirai (SEARPI) show that the events that have caused the greater disasters in the region have appeared in 1983, 1992, 2006 and 2007.

-The river has freedom of moving and the course is not confined. Upstream the slope of the river varies from 0.3% to 0.1%. The downstream region can be considered as a depositional area for the sediments transported by the river. The downstream portion of the basin of River Pirai thus is a sediment receptor. It therefore forms a large alluvial fan which presents different problems of deposition that affects the economical development of the region.

-The river has a permanent tendency to avulsion
- sudden change of the course of the river – since the river is not confined and the flow overflows over the shores. The slope of the river varies from 0.3% to 0.01%.

-In Santa Cruz the River is not contaminated by industry. However in the adjacent districts (Warnes, Montero, Belgica, Okinawa and Portachuelo) the river is heavily contaminated by industry, agriculture and domestic use. In Santa Cruz, the quality of the water isn't very good either because the local water plants throw the served waters sewage waters into the river. (mostly fecal).¹⁷



Figure 3.3 showing sewage water thrown into the River.

17. Mauricio Florencio, Villazon, Aranibar Christian Roy, and Patrick Willems. "Hydrodynamics Unsteady Flow Model Applied to Pirai River for Flood Events Estimation in Santa Cruz, Bolivia." (2009.)

TOPOGRAPHY

- The topography is flat. However a minor difference of 1 meter is present on the east-west direction. The highest point is closer to the river, while the lowest point is closer to the city.

-Within the green zone there are no marked changes in level, only some waves caused by the vehicular traffic around the edge.¹⁸

- The Water edge presents topographic changes due to the hydrologic cycles of the river.

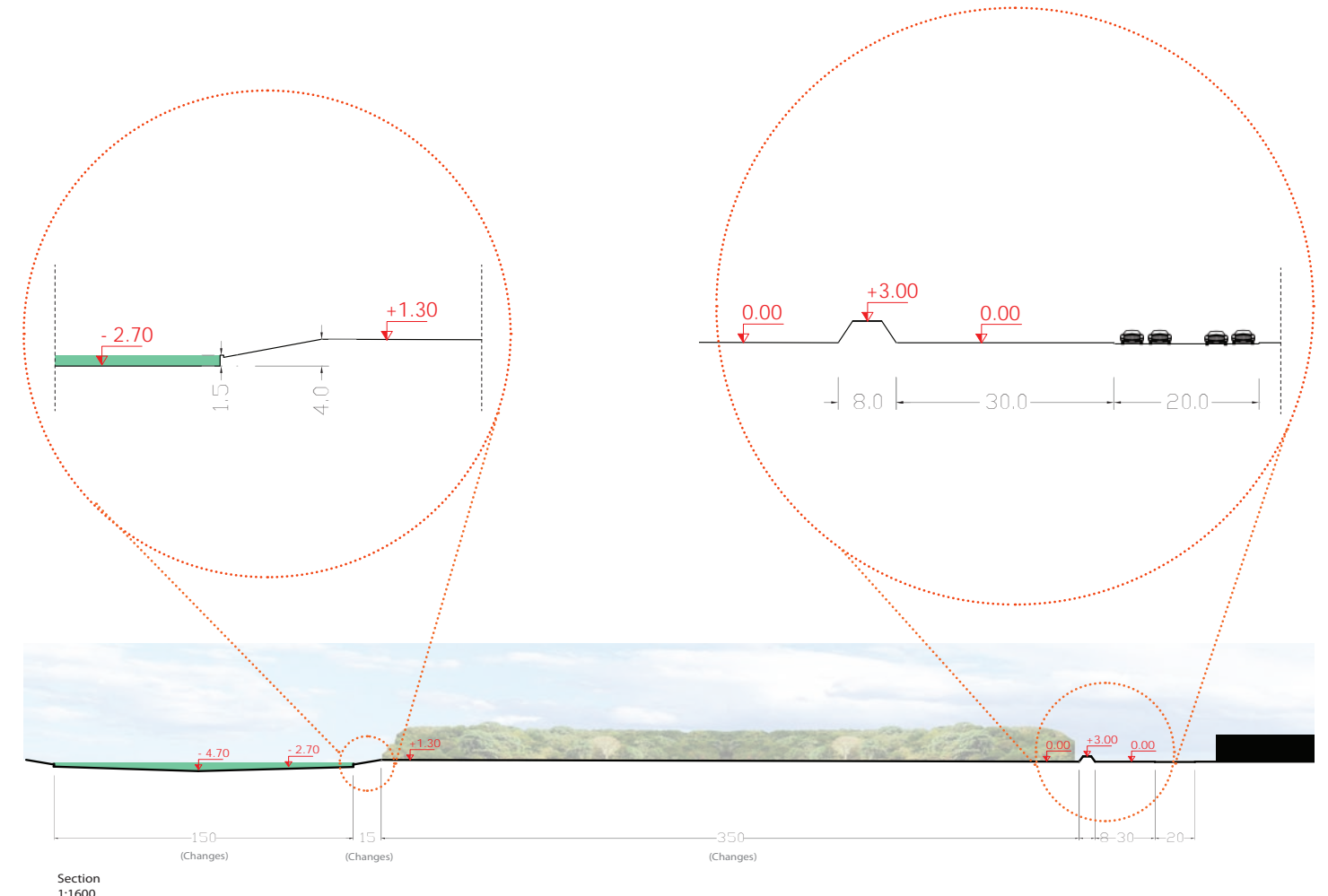


Figure 3.4 Section across the site.

18. Mauricio Florencio, Villazon, Aranibar Christian Roy, and Patrick Willems. "Hydrodynamics Unsteady Flow Model Applied to Pirai River for Flood Events Estimation in Santa Cruz, Bolivia." (2009.)

CURRENT INFRASTRUCTURES USED TO STABILIZE FLOODING

The infrastructures currently used to protect the River from flooding are located on the Eastern and Western edges of the Green Belt. On the River edge, the infrastructures used are stone and/or wood.¹⁹On the side closer to the city, the infrastructures used are dikes and they are composed of pressed earth. Locating the protective infrastructures on both edges and making them very steep reduces costs; however, they impede

the inhabitation of both the Green Belt and the River. These infrastructures act as barriers that separate the city from the Green Belt and the Green Belt from the water. Instead of thinking about these infrastructures as barriers, we should think about them as transitions that incorporate the Green Belt and the River as main elements that improve the daily experience of the city.

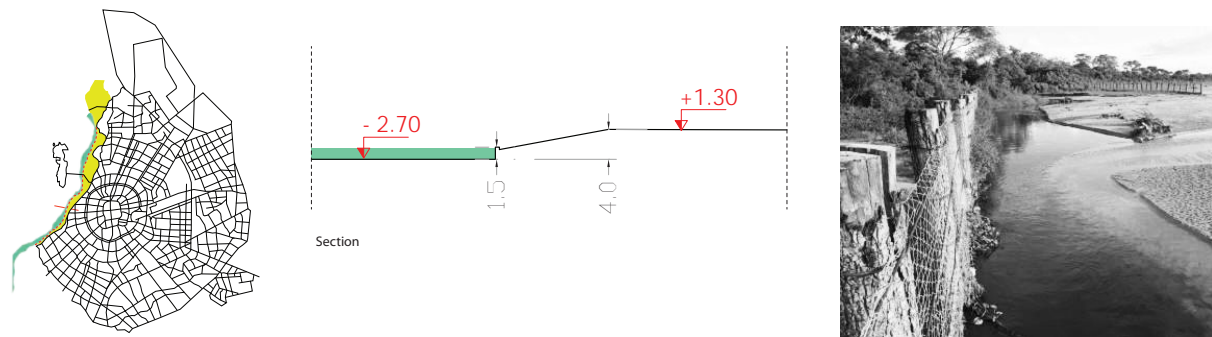


Figure 3.5

First Barrier: Gully. It is composed of wood. It cover approximately 8.5. It is located on the edge to the water.

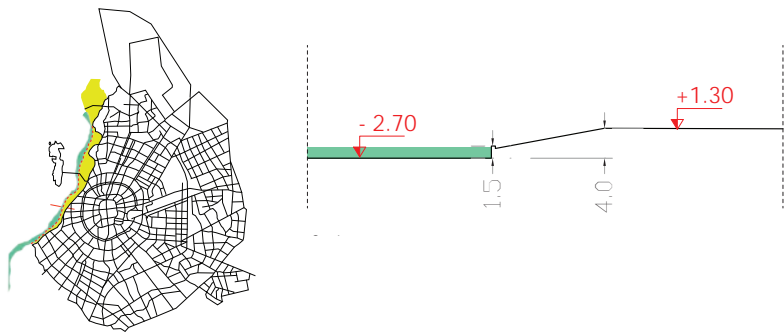


Figure 3.6

First Barrier: Gully. It is composed of one. It cover approximately 8.5. It is located on the edge to the water.

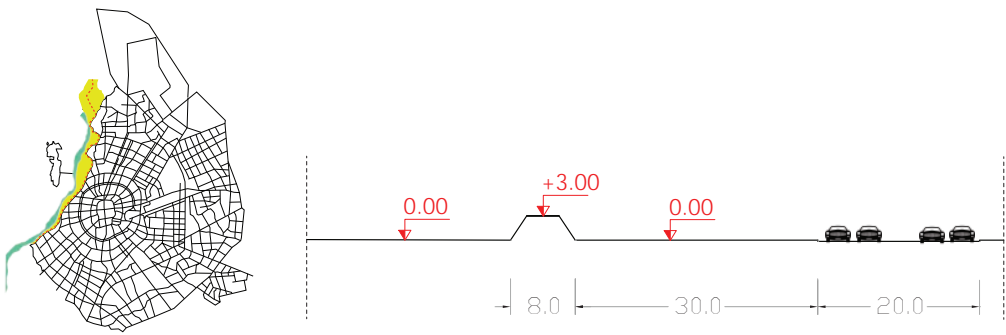


Figure 3.6

Second Barrier: Dike. It is composed of pressed earth and is 3 meters higher than the city. It covers approximately 15 km. It is located on the edge to the city.

19. Searpi. "Cuenca Hidrografica del Rio Pirai" (2012)



RE-THINKING THE GREEN BELT

-How can the Green Belt be re-thought in order to adapt to the fast developments of the city?

-How can the Green Belt be used as an interface without getting harmed?

-How can infrastructure help the environment instead of harming it?

-How can infrastructure enhance the connection with the River?



"Landscape is not only a formal model for urbanism today, but perhaps more importantly, a model for process."

- Stan Allen

HOW CAN THE GREEN BELT BE RE-THOUGHT IN ORDER TO ADAPT TO THE FAST DEVELOPMENTS OF THE CITY?

Currently, Green Belts are used in order to control the growth of cities. However, I may argue that being a physical boundary for urban sprawl is not the only function of the Green Belt. The Green Belt should also be a zone of transition between the different city centers in the Modern City. As the city evolves from the Ancient City, to the 19th-Century City, to the Modern City, it changes in form and function. The city goes from a condensed center (Boiled Egg), to a central organization that extended beyond the perimeter of the center (Fried Egg) to a decentralized city with multiple centers (Fried Egg).²⁰ As the city reshapes and reorganizes itself through time, so has to do the Green Belt. Therefore I can say that it is impossible that the city of Santa Cruz has gone through so much change in the last 30 years, and yet, the spatial and formal manifestation

of the Green Belt remained the same. The Green Belt can't remain still and ignore what happens in its surroundings; instead, it has to keep up with the current conditions of the city. Therefore we can ask: how can the Green Belt adapt to the new developments of the city? What is the new role of the Green Belt? The Green Belt has to act as an interface among city centers. As Santa Cruz develops into a Modern City typology with multiple centers, new city centers beyond the Green Belt are created. I think that the Green Belt is an opportunity to enhance the network of multiple city centers and yet provide the city with open green space that balances the density of the urban mass. Through the re-development of the Green Belt, a transition between city centers would be created.

20. Graham Shane, "The Emergence of Landscape" *The Landscape Urbanism Reader* (New York: Princeton Architectural Press, 2006), 55-68.



Figure 4.1 Diagram comparing Cedric Price's "City as an Egg" with the evolution of Santa Cruz's footprint.

PRECEDENT: MASTERPLAN FOR SHENZHEN

ARCHITECT: TOM VEREBES
CITY: SHENZHEN

Eventhough Tom Verebe's Masterplan for-Shenzhen, China doesn't necessarily refer to the integration of nature and the man made, I started to use it as an example that explores the way in which densities of patterns influence the inhabitation of a place. Tom Verebe's Master plan for Shenzhen, China focuses on the adaptability of the urban fabric to development. The urban fabric shouldn't be seen as a fixated print, instead, it is an evolutionary pattern that changes through time and adapts to the city's needs. In this case, Verebe and his students created modules that were repeated in order to create various densities. The same module changes in scale and height in order to generate different ways of occupying the same site.²¹ However, Shenzhen's Masterplan not only explores the evolution of the pattern

through time, but also the formal expression of it. Every pattern is designed to relate in different manner to the existing fabric. By exploring different densities, both horizontal and vertical, the pattern starts to dictate how the city is supposed to feel like. Through changes in density, a different speed to the city is given. However, it is important to highlight that both the masses and the voids play an important role in the design. The voids within the patterns start to dictated specific pauses that influence the urban experience of the city. Also, it is important to notice that the volumetric exploration not only influences the experience within the fabric, but also beyond it. Water is seen as an extension of the city and not as a boundary for it. The modules expand through and beyond the water in order to integrate both sides of the river edge.

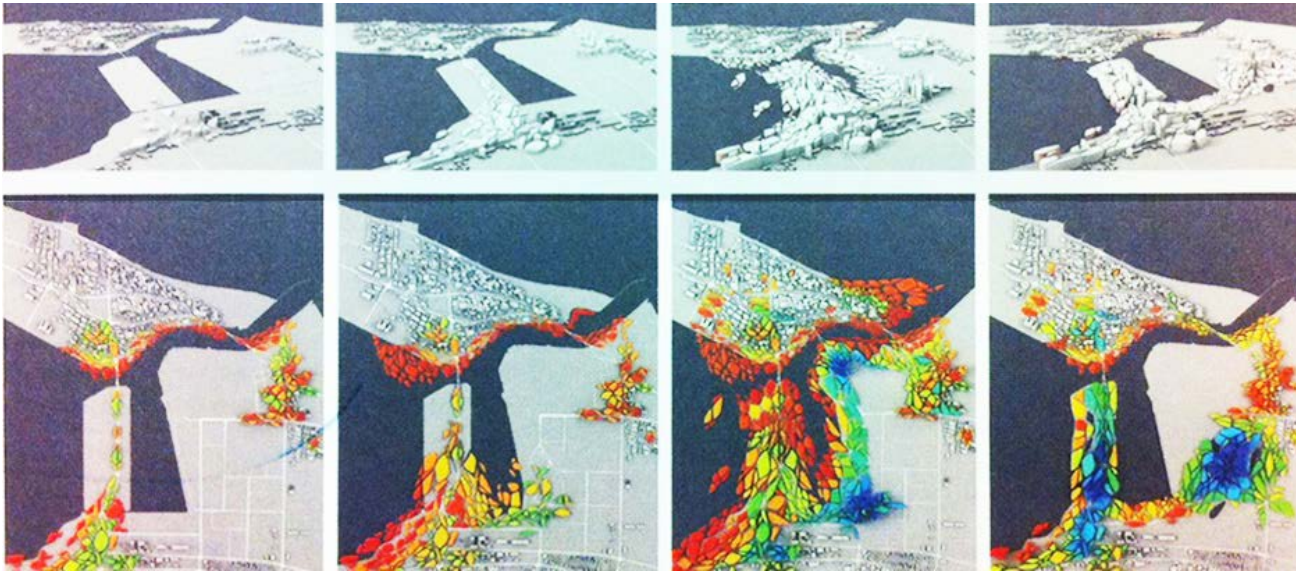


Figure 4.2 - Masterplan for Shenzhen: Volumetric and Plan exploration of changes in density through time.

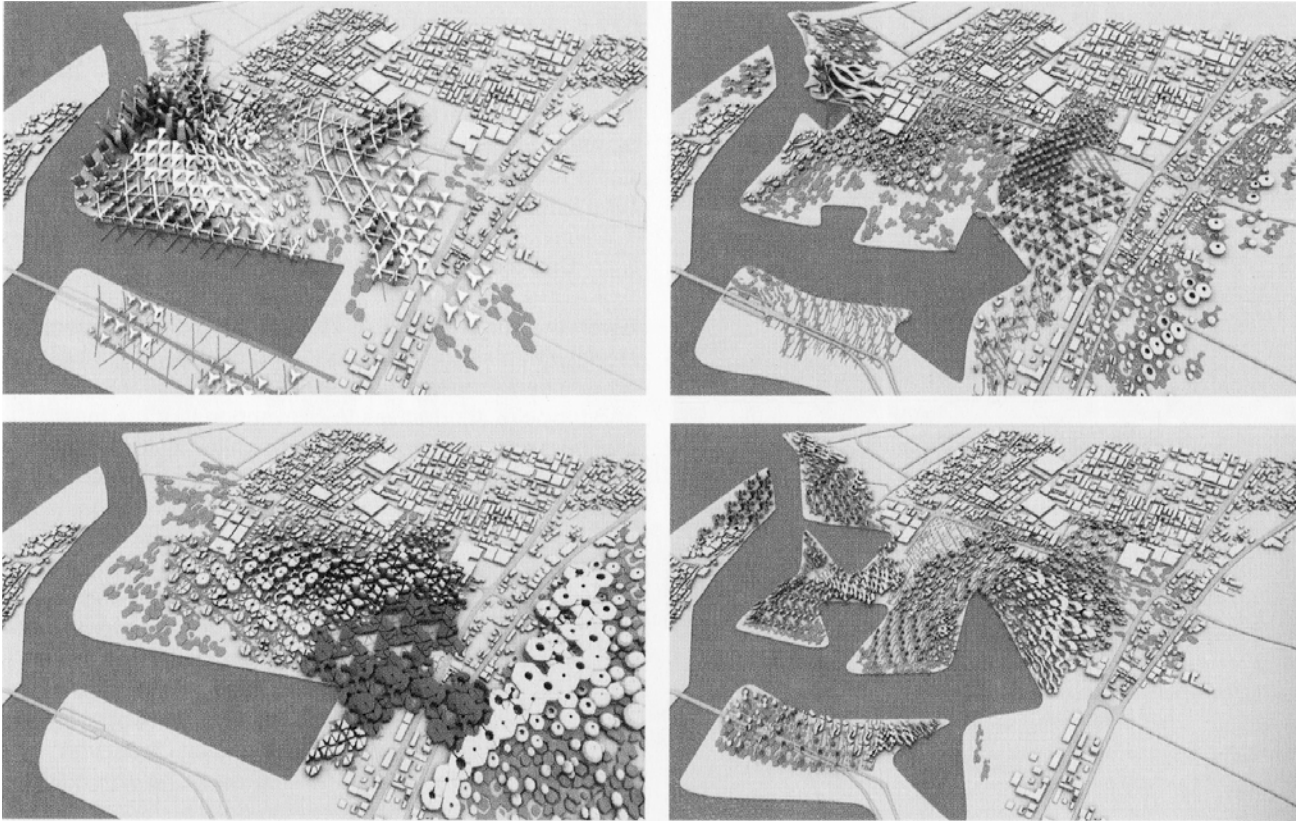


Figure 4.3 - Masterplan for Shenzhen: Formal exploration of the pattern in order to create different experience of the urban fabric.

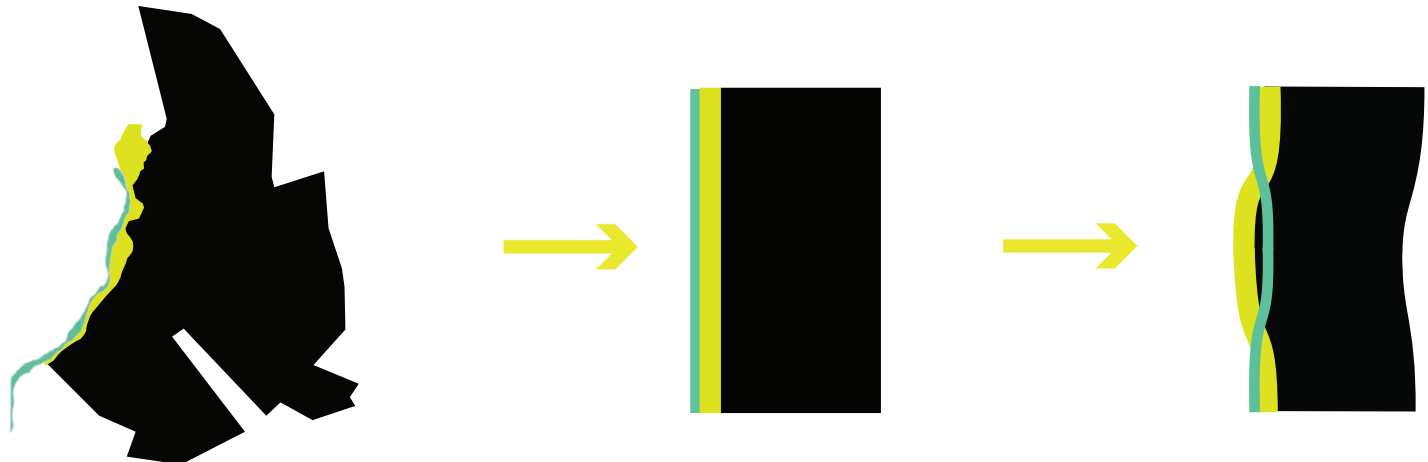
21. Davis, Juliet, "Sustain and Develop", (New York: Princeton Architectural Press, 2009), 35-43.

HOW CAN THE GREEN BELT BE USED AS AN INTERFACE BETWEEN CENTERS WITHOUT GETTING HARMED?

By enhancing the inhabitation of the Green Belt a fluid connection between multiple city centers would be provided. This way the Green Belt would be no longer seen as a barrier, but as a transition between the weight of the city and the openness of green spaces. The idea is that by inhabiting the Green Belt people would start to understand it and would see it as an extension of the city rather than a boundary. Through inhabitation people would get aware of it; of its presence, its scale, its aesthetic, its ecology. Otherwise people know that it stands there, but they are not fully aware of what its function is and how that can actually improve the daily experience of the city itself. However, there is the need to set up parameters of development as a way to start inhabiting the Green Belt without harming it. A new plan that sets up rules for development in the site with the aim of protecting the existing ecology is the goal. One strategy to start to think about the interaction of uses on the land is by looking at patterns as organization methods for land. By focusing on patterns as elements of organization we

can start to think about lot division, proportion of lot vs. built space, constructed footprint, directionality, access, sequence, public space and height. These elements would start to set up parameters for construction which respond to both the natural and man-made contexts. The main components of the patterns would be natural green spaces, programmed green spaces and infrastructure. The way in which these three elements interact would have the goal of promoting the spatial awareness of the natural, while enhancing the inhabitation of it through programmed spaces. Program would be represented in the form of open green spaces and infrastructures that would be arranged in order to create a promenade down to the river edge. The aim for re-activating the connection between the city and the river is to establish a physical connection to the main natural element: the water. By introducing new types of infrastructures that prevent the city from flooding and support the environment instead of harming it, a conscious interaction between the natural and the man-made will be proposed.

RIVER + GREEN BELT + CITY



The river, the Green Belt and the city don't interact in a physical or spatial manner. Instead, they are presented as different layers of space and material that are located next to each other. How can we integrate them spatially to create a physical experience on the River Edge?

PATTERNS AND LAND ORGANIZATION

Series of Pattern Studies that explore the interaction between:

water

development

programmed green spaces

natural green spaces



Pattern 1
The pattern continues the current proportions of the blocks in the urban fabric, creating a density towards the river edge. Both architectural infrastructure and programmed green spaces are altered with natural green spaces and start to frame them. This creates a natural green space zone in the middle that allows the continuous interaction with the natural landscape.



Pattern 2
The pattern inverts the current structure of the city and uses programmed green spaces as the blocks. Infrastructure continues the streets' proportions and direction. The infrastructure is seen as series of inhabitable walls that interact directly with the programmed green spaces, creating a promenade towards the river while serving as protection from flooding.



Pattern 3
The pattern continues the current proportions of the blocks in the urban fabric, creating a density towards the river edge that acts as protection against flooding. The promenade towards the river is created through series of programmed and unprogrammed green spaces.

PATTERNS AND LAND ORGANIZATION

Series of Pattern Studies that explore the interaction between:

water

development

programmed green spaces

natural green spaces



Pattern 4
This pattern also continues the current proportions of the blocks in the urban fabric, creating a density towards the river edge. Both architectural infrastructure and programmed green spaces are altered in order to create density towards the River edge. Programmed green is pushed to the middle zone in order to allow a continuous promenade to the water.



Pattern 5
The pattern inverts the current structure of the city and uses programmed green spaces as the blocks. Infrastructure frames the programmed green spaces and creates series of barriers against flooding.



Pattern 6
The pattern continues the current proportions of the blocks in the urban fabric, creating a linear axis towards the river edge.

PATTERNS AND LAND ORGANIZATION

The volumetric study of the patterns allows seeing how the landscape can be manipulated in order to achieve the integration of water, nature and infrastructure on the site. Also, the vertical expression of the masses start to speak about the overall massing characteristics and spatial connections established by each pattern.

Pattern 1 establishes a pixelation of the urban fabric that increases in volume and density as it approaches the water.

Pattern 2 acts as series of walls, which get taller as they set back from the water edge. This shows that the further back the walls are, the more protective they are. Pattern 3 shows infrastructure as a louver for flooding.

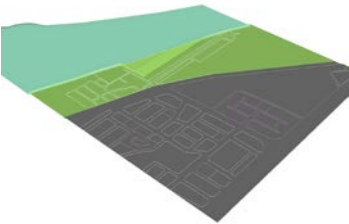


Figure 4.4 Re-shaping the landscape to allow connection with the water.

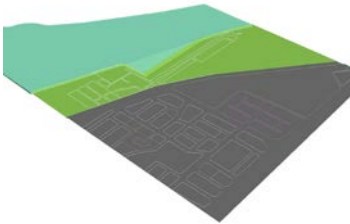


Figure 4.5 - New connection to the water allows flood.

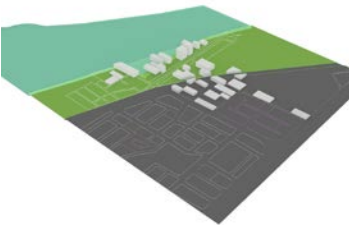


Figure 4.6 - Pattern 1 on the site.

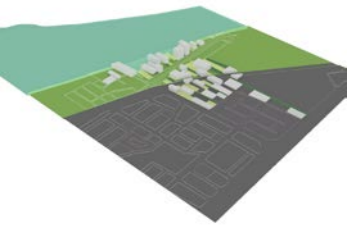


Figure 4.7 - Pattern 1 -infrastructures and programmed green spaces.

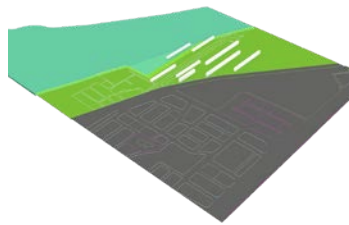


Figure 4.8 - Pattern 2 on the site.

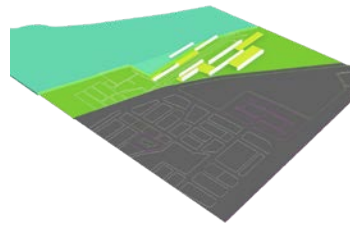


Figure 4.9 - Pattern 2 -infrastructures and programmed green spaces.

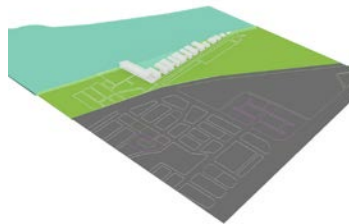


Figure 4.10 - Pattern 3 on the site.

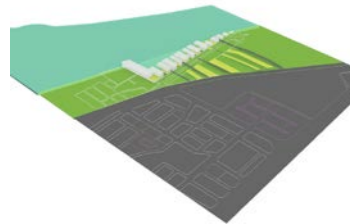


Figure 4.11- Pattern 3 -infrastructures and programmed green spaces.

The Frontal view of the patterns show how the manipulation of the landscape and the introduction of the steps allows a spatial and experiential connection between land an water.

It also shows that in each pattern the relationship between infrastructure and water is different.

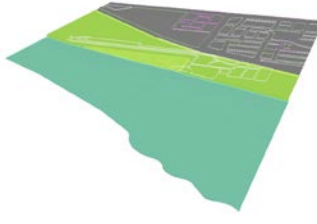


Figure 4.12 Re-shaping the landscape to allow connection with the water.

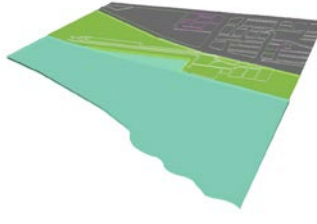


Figure 4.13 - New connection to the water allows flood.

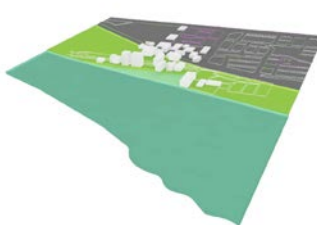


Figure 4.14 - Pattern 1 on the site.

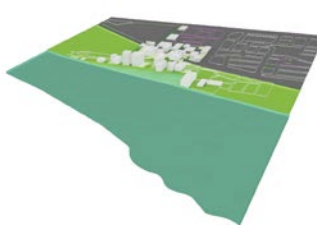


Figure 4.15 - Pattern 1 -infrastructures and programmed green spaces.

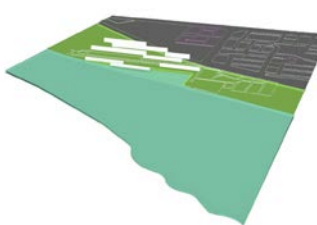


Figure 4.16 - Pattern 2 on the site.

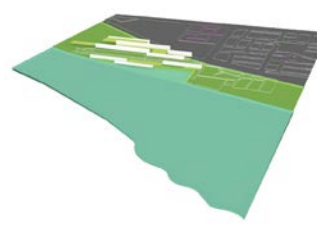


Figure 4.17 - Pattern 2 -infrastructures and programmed green spaces.

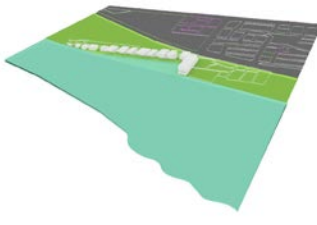


Figure 4.18 - Pattern 3 on the site.

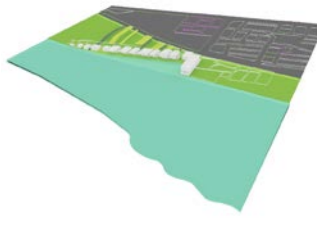
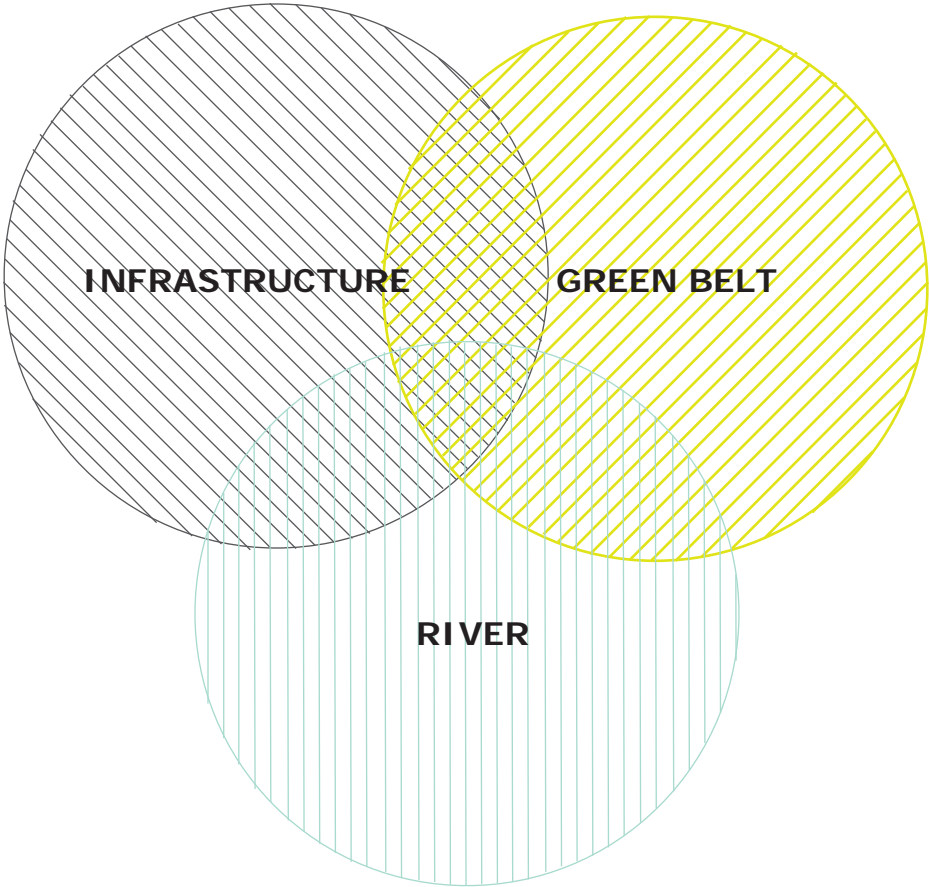


Figure 4.19- Pattern 3 -infrastructures and programmed green spaces.

HOW CAN INFRASTRUCTURE HELP THE ENVIRONMENT INSTEAD OF HARMING IT?

It is necessary to go to an architectural scale to resist the forces of the contemporary city. Even though there are lots of lessons to be learned from landscape, landscape by itself doesn't have the power to counteract the bulk and force of development by itself. It needs planned infrastructure that supports and protects it.²² One way these infrastructures can do so is by creating parameters of construction in the site that start to influence code and FAR on the area. By going through volumetric exploration of the pattern, we can also start to think about

the infrastructures as structures for flooding. By establishing measurements for footprint and height, these infrastructures can start to act as protective structures against flooding. This way, through infrastructure the original purpose of the Green Belt as a cushion for flooding would be enhanced and spatially manifested. Through this new spatial strategy that integrates nature with development, the Green Belt can not only be re-thought as a transitional space instead than as a boundary, but it can also recover its original purpose: protect the city from flooding.



22. Allen, Stan, "Landform Building: Architecture's New Terrain [Hardcover]." Landform Building: Architecture's New Terrain, 250-264.

PRECEDENT: GOWANUS LOWLINE COMPETITION

ARCHITECT: TOM VEREBES
CITY: SHENZHEN

The Project responds to Gowanus Canal’s water contamination. Gowanus Canal presents a similar condition from Pirai’s River because as the city starts to develop, it moves away from the water. This intervention addresses both the ecological and urban issues of the site in order to improve the current conditions and enhance the inhabitation of the site. Wetlands and infrastructures are combined in order to increase density in the area. Towers integrate with the wetland ecosystem and produce on site power and function as vertical stacks of apartments and educational facilities that allow the neighborhood to double its existing population while also maintaining significant areas of open space.²³

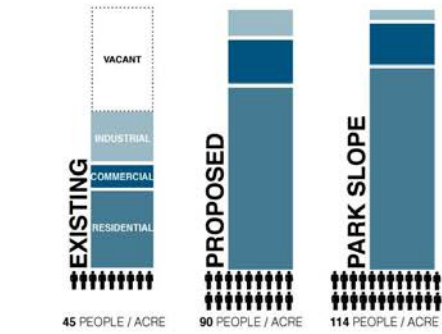


Figure 4.20- Diagram showing the changes in densities.

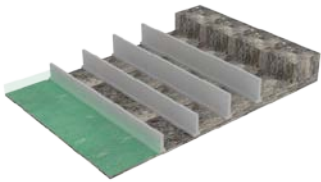


Figure 4.22- Retaining walls also work as infra-structures for flooding.

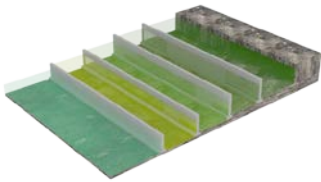


Figure 4.23- Wetlands

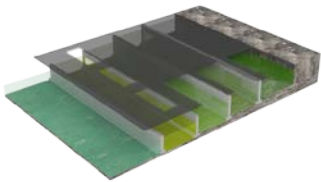


Figure 4.24- Pedestrian bridge

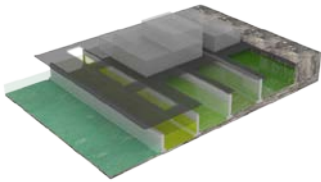


Figure 4.25- Program

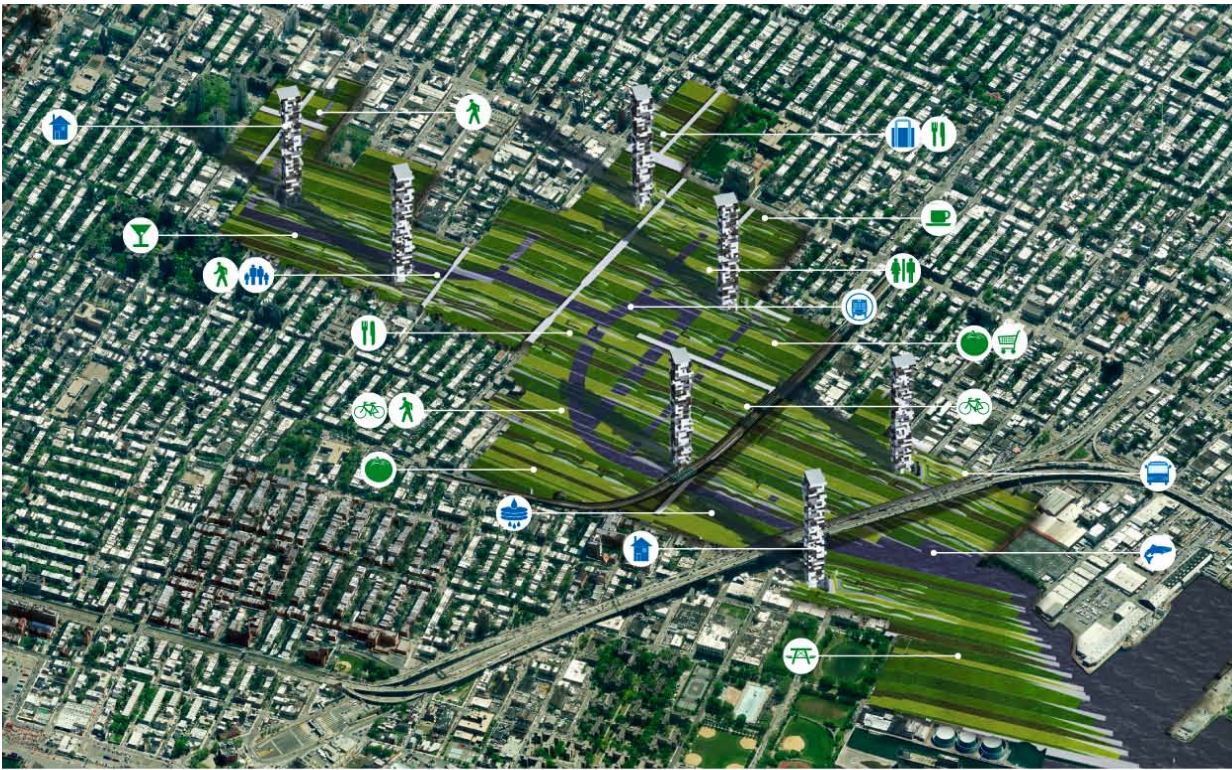


Figure 4.21- Site Plan



Figure 4.26 - Sectional Perspective

Wetlands are composed of series of layers that work in tandem to create an ecosystem. The urban ecosystem includes circulation and programing that operates at the pedestrian level. By peeling up the layers of fertile substrate, new spaces for retail program can be defined beneath, while circulation is elevated above the natural ecosystem. New streets that connect back to the surrounding grid allow for the pedestrian traffic to populate and utilize the space around the canal without compromising its natural functions.²⁴

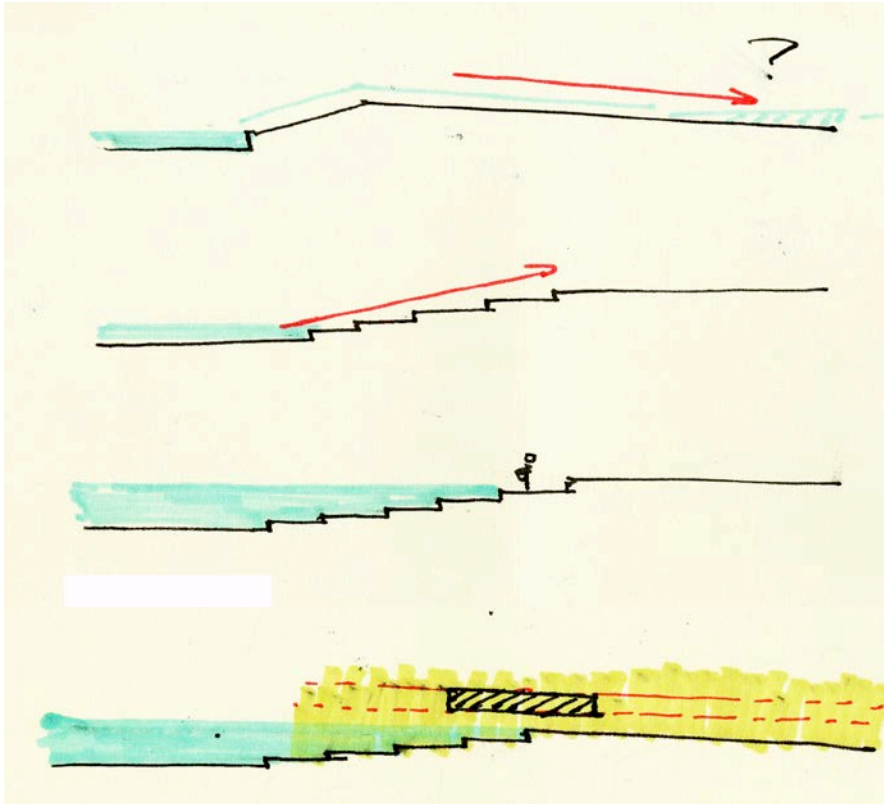
23. Tyler, Caine, Carnahan Luke, and Specketer Brandon. "Gowanus Lowline Competition Winners."

24. Tyler, Caine, Carnahan Luke, and Specketer Brandon. "Gowanus Lowline Competition Winners."

HOW CAN INFRASTRUCTURE ENHANCE THE INHABITATION OF THE RIVER?

Infrastructure serves both the natural and the man-made. Besides protecting the city from flooding, infrastructures help cleaning the water and encourage the human development on the site. By introducing structures that combine ecosystems that purify the water and host program, the community would extend to the water edge, promoting the inhabitation of it. The success of the expansion of the city into the water edge relies on the conscious interaction between the two. The inhabitation of the Green Belt not only

only responds to the city's augment in density, but also proposes that the people would reconnect with nature and learn from it. This way the interaction between the natural and the man-made would be conscious and through, and people would start to understand what the role of the Green Belt is and how its ecosystem improves the daily experience of the city. This infrastructures, which are containers of program, would celebrate the existence of the Green Belt by creating a unique experience on the water edge.



CURRENT LANDSCAPE
CONDITION

PROPOSED LANDSCAPE

EXPERIENCE OF WATER:
THE THEATRICAL SETTING

PROGRAM

PRECEDENT: TOWER OF BELEM

ARCHITECT:
CITY: BELEM, PORTUGAL

While the city uses solid walls as protective structures from the water, these walls break at one specific point in order to celebrate the connection between the city and the water. This break creates a theatrical connection between the city and the water, which makes the experience of the place unique. When the water level raises, the water becomes part of the theatrical setting and the spaces within the city take flooding as part of the play. The steps on the break blur the boundaries between land and water by allowing the water to overflow them. In Belem water is part of the daily lives. It is a medium of transportation, an economic resource and the main component of the landscape. The presence of water gives Belem an amazing experience which makes it unique.



Figure 4.27 - Inhabitation of the water beyond the wall

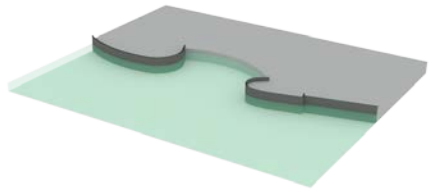


Figure 4.28 - Relationship between water, flooding infra-structures and the landscape

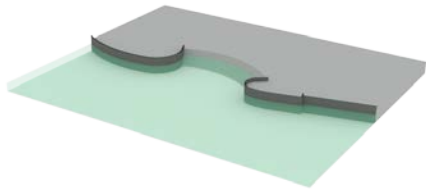


Figure 4.28 - Steps create a setting that allow the inhabitation of the water.

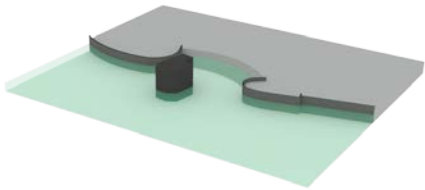


Figure 4.29 - The Tower of Belem marks an axis that reinforces the connection to the water and celebrates inhabitation beyond the landscape.



Figure 4.28 - Belem Top View

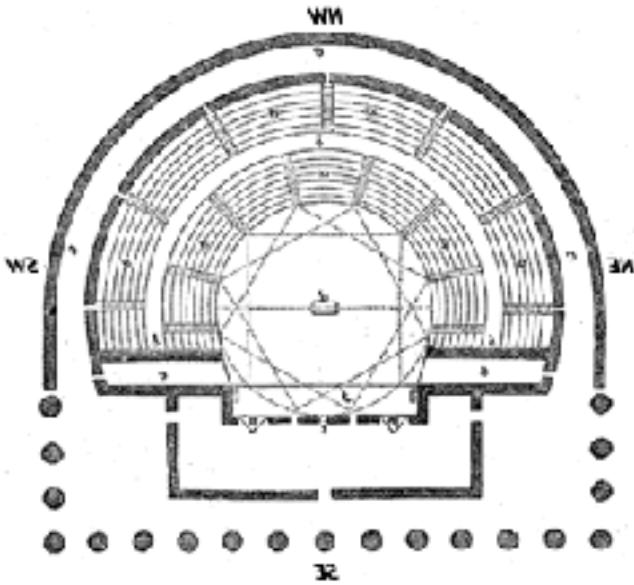


Figure 4.29 - Theater Typology plan



PROPOSAL

-Analysis

-The Site

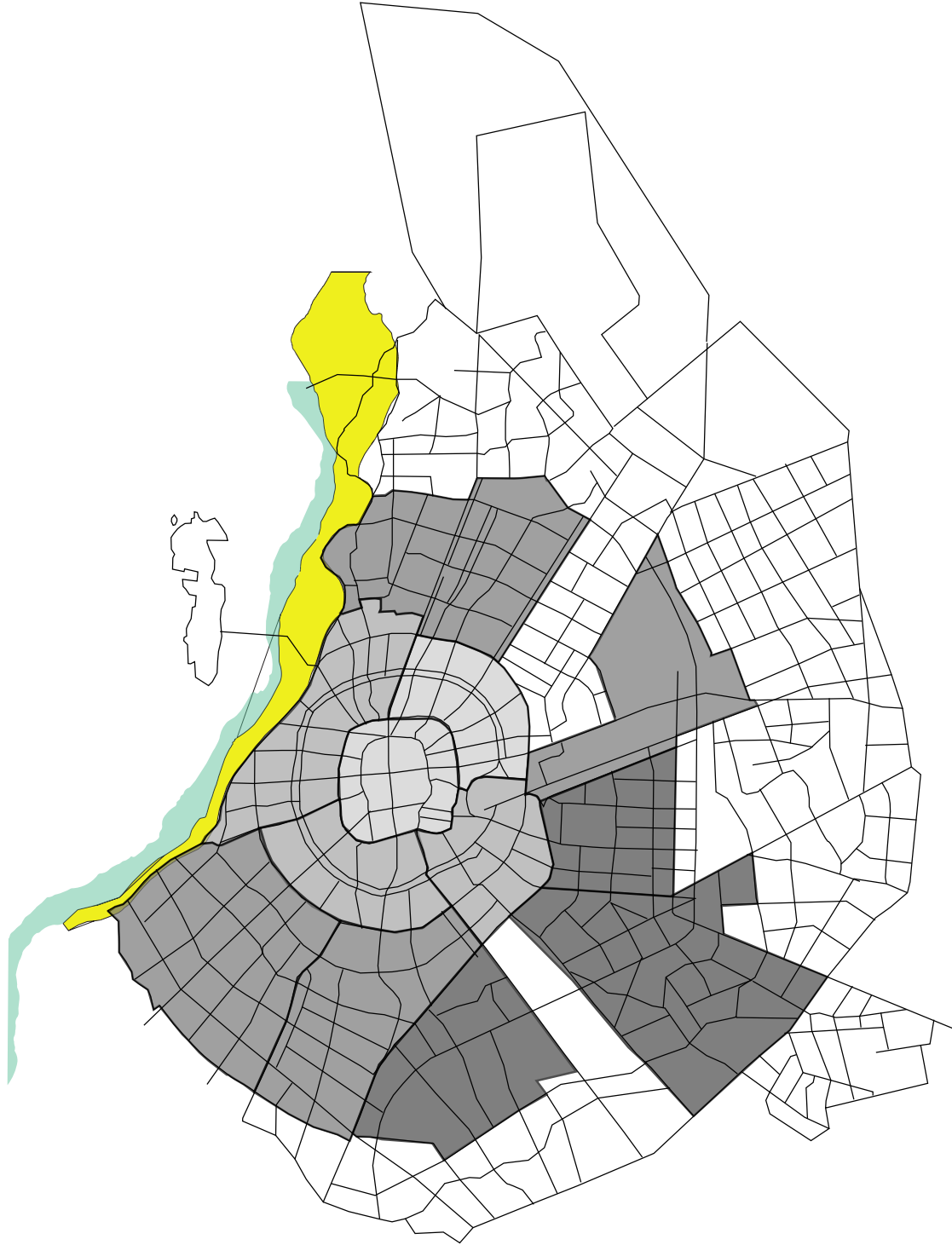
-What can be developed on the site?

-How can it be inhabited?

POPULATION
IN
POVERTY

- 82 - 86%
- 58 - 71%
- 37 - 49%
- 17 - 25%

The percentages show that the differences in poverty levels create a radial separation within the city.

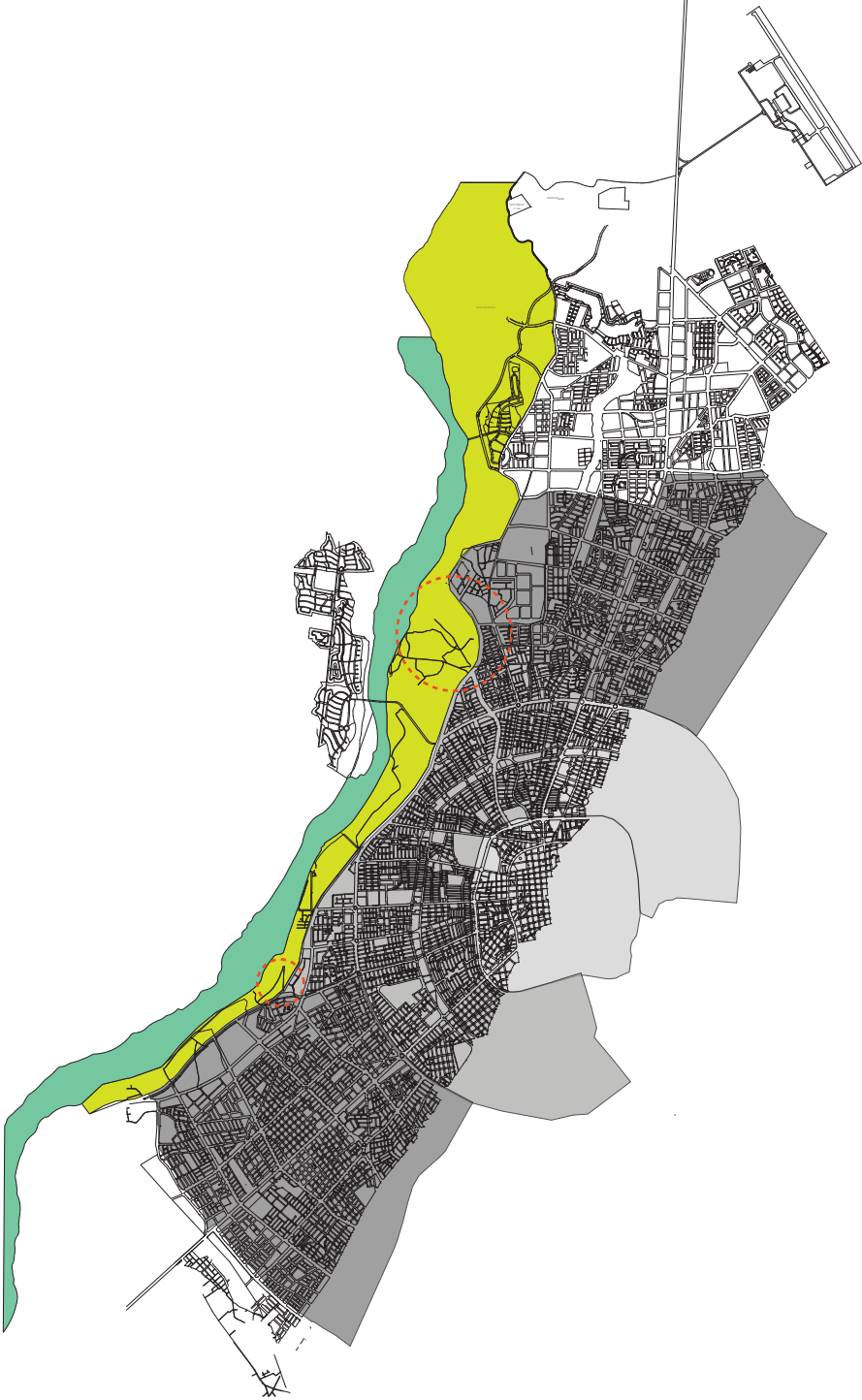


CONNECTING
THE CITY

- 58 - 71%
- 37 - 49%

The Green Belt is an opportunity to link the different socio economical groups that are strictly divided by the radial organization of the city. The division lines among the adjacent districts of the Green Belt become crucial and are considered potential sites.

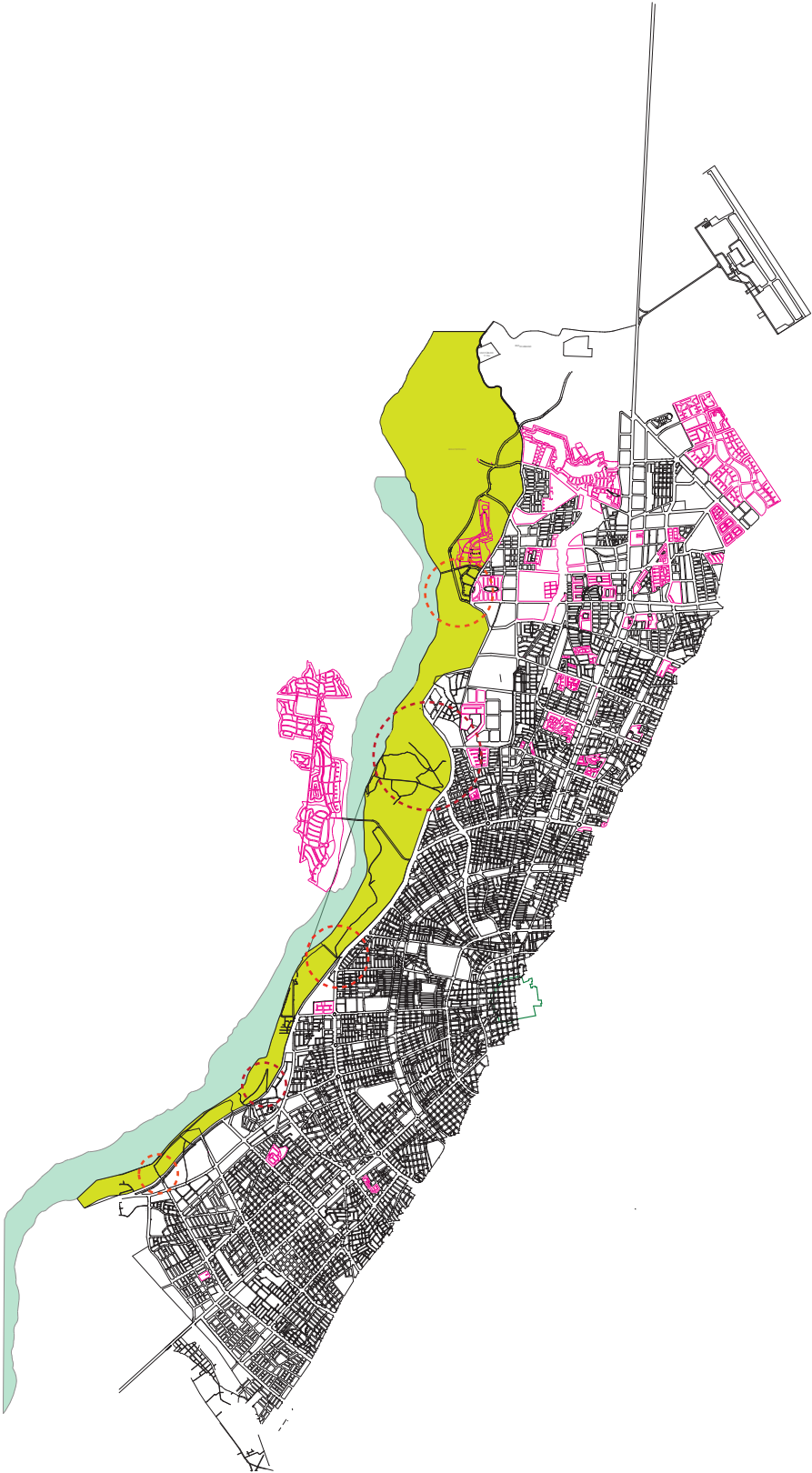
- Green Belt
- Pirai River
- Proposed Sites



CONNECTING THE CITY

Recently, gated communities have been developed in the northern part of the city. This has created segregation among the private developments and their surroundings, as well as a clear differentiation between the north and the south. Even though poverty levels evolve radially, we can see that the economic inequality is higher in the north than in the south. Although the poverty percentage appears to be the same in both zones of the periphery, we can see that in the south there is less economic disparity than in the north. In the north, the poor are poorer and the rich are richer. The statistics are evened out with the introduction of the gated communities, which host people with a high economic level. The Green Belt is an opportunity to explore how these gated communities interact with their surroundings in a public spectrum. Points are picked in order to create a sequence that links the north and the south.

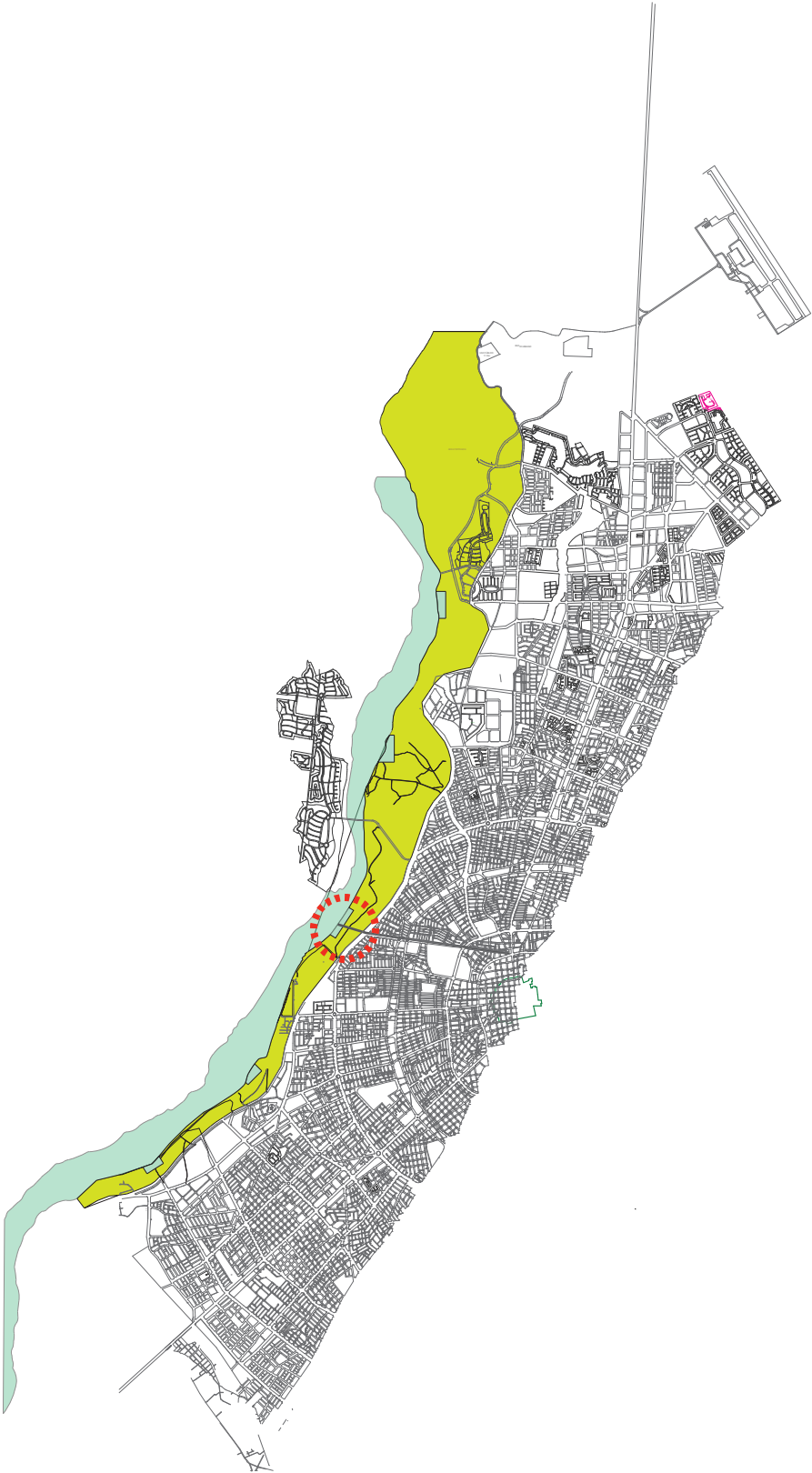
- Green Belt
- Pirai River
- Proposed Sites
- Proposed Sites
- Gated Communities



CONNECTING THE CITY

Water is pushed into the Green Belt in order to create direct interaction between the River and the City. These pockets of water will not only contribute to the experience of the sequence, but also will also works as infrastructural support to control flood.

- Green Belt
- Pirai River
- Proposed Sites
- Proposed Sites
- Gated Communities



THE SITE

The site chosen explores future connections between the city and the new city center on the opposite side of the river. Currently, there is a project on the site to develop a second bridge that trespasses the Green Belt in order to get to the opposite side of the river. But, how can the site be used not only as a connecting bridge but also as a destination point? Besides being a key point for the further development of the city, the site offers the unique experience of connecting the city with the water.



Figure 5.1 - Current Plan for new Bridge



THE SITE



Figure 5.2



Figure 5.3



Figure 5.4

SITE

Green Belt River Educational Facilities Commercial Mix-Use Health Historical Green Areas Main Streets

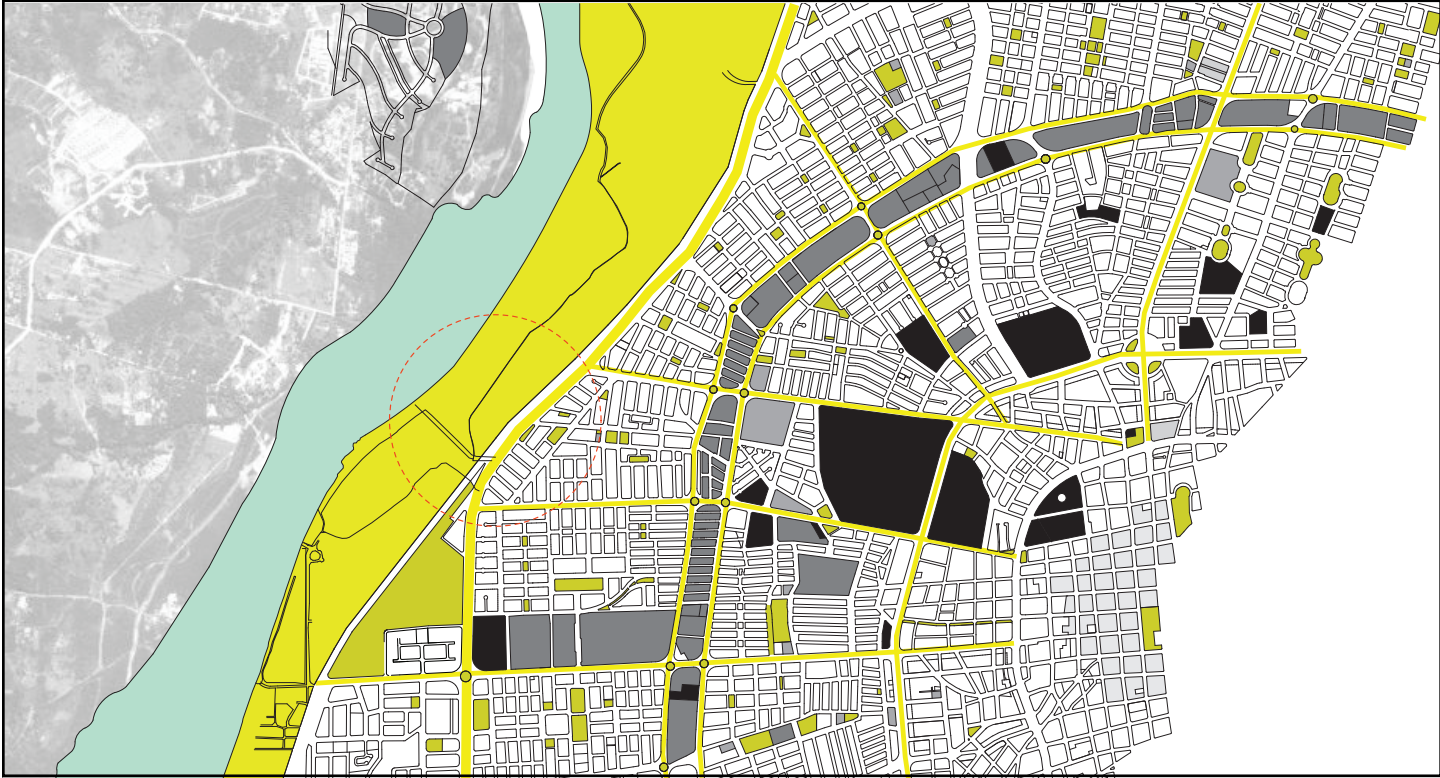


Figure 5.5 - Current Site Plan

Green Belt River Educational Facilities Commercial Mix-Use Health Historical Green Areas Wetlands

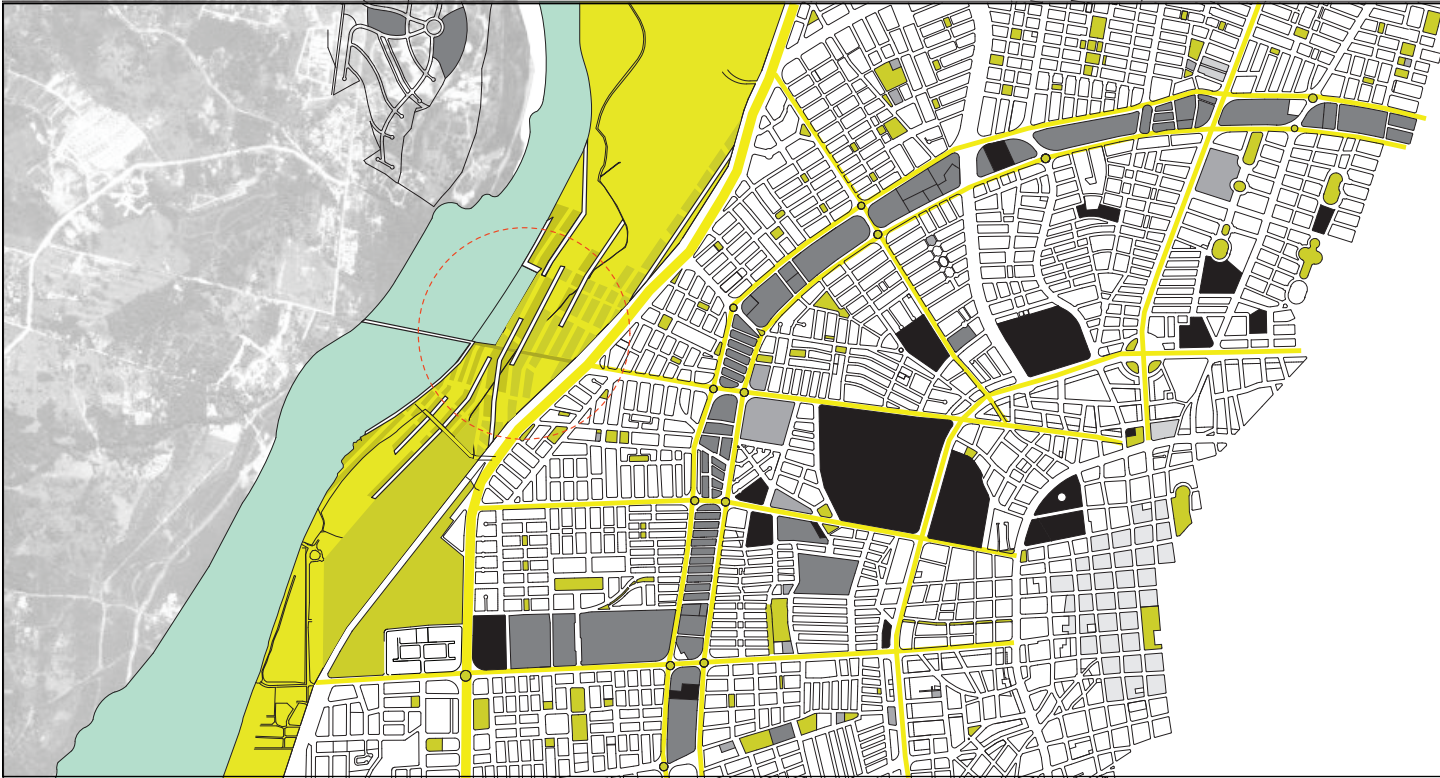


Figure 5.6 - Proposed Site Plan

WHAT CAN BE DEVELOPED ON THE SITE?

With a population that could double to reach 5 million within 2 decades, Santa Cruz struggles between two extremes - urban sprawl and urban density. These examples, which express maximum expansion and maximum concentration, challenge the functionality of the city. However, as the migration increases, more densification is implemented. In order to serve the massive urban population influx, a big drastic increase in housing stock would be needed. However, during developing process not only infrastructure in the form of housing should be developed. Public spaces are also key points that should be considered during developing process. The re-consideration of the Green Belt as a major public zone that links the two main areas of development would be a big contribution to the urban experience of the city.

According to the Law, the following programs can be inserted in the site:

Article 13: The Protected area cannot be used for any agricultural or forestall purpose. It can only be used for hydro energetic, recreational, research or educational purposes. The Protective zone is considered State's territory. All the private property within the green zone has to be reforested and can be used only for ecological purposes.²⁴

-  EDUCATIONAL
-  RESEARCH
-  RECREATIONAL
-  HYDROENERGETIC

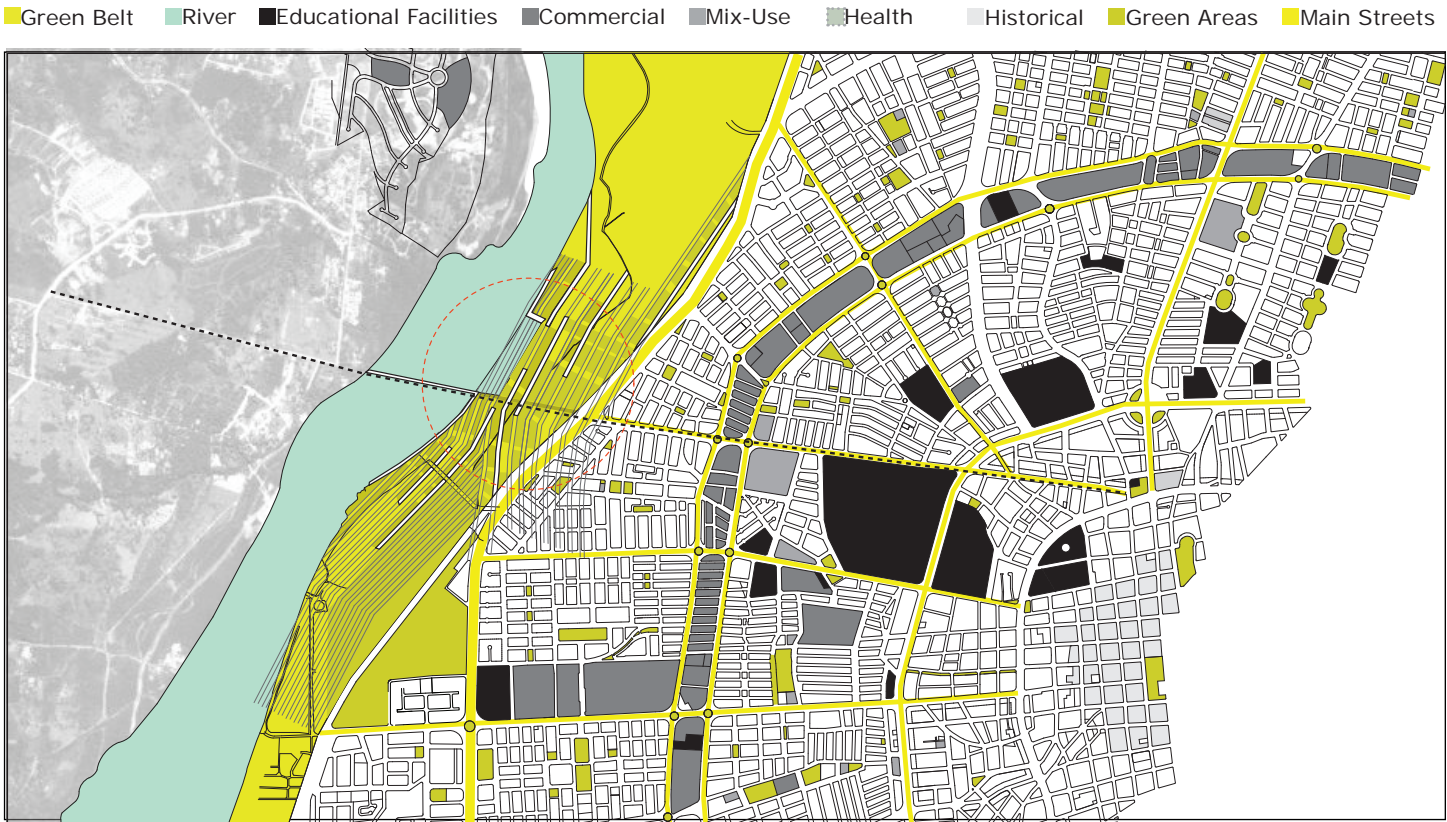


Figure 5.7 - Site as a public zone that links the two city center by encouraging the inhabitation of it.

24. Searpi. "Cuenca Hidrografica del Rio Pirai" (2012)

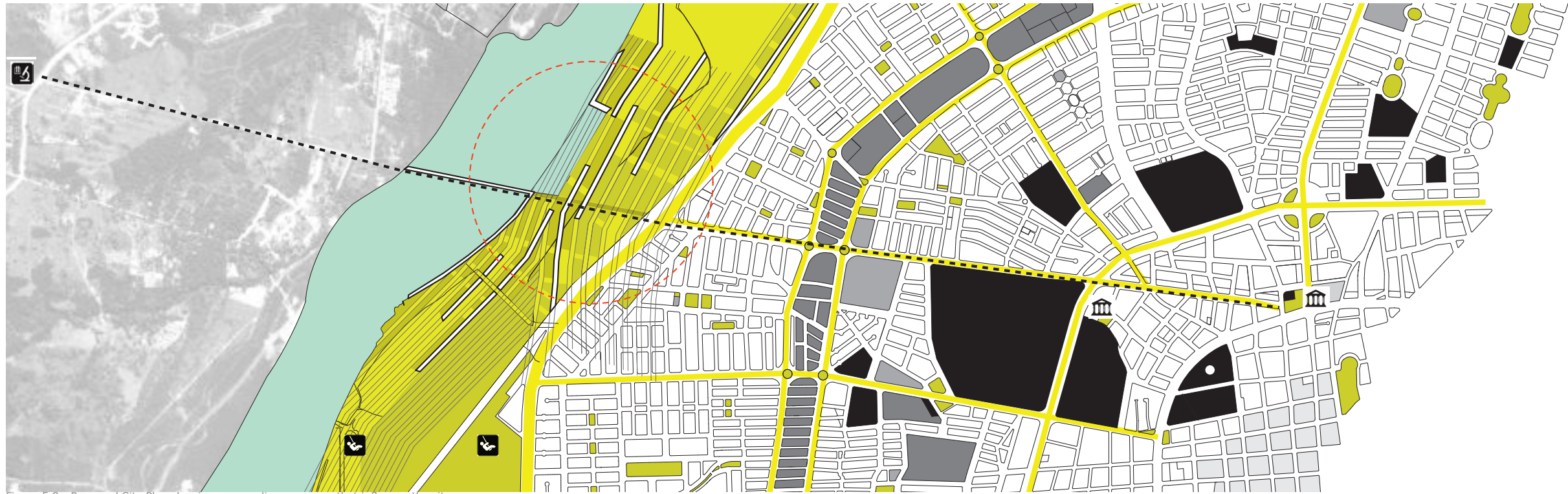


Figure 5.8 - Proposed Site Plan showing surrounding programs that influence the site.

- Green Belt
- River
- Educational Facilities
- Commercial
- Mix-Use
- Health
- Historical
- Green Areas
- Main Streets

The site lies on an axis with the Municipal Library. The proposal extends the Educational facilities on the site with the aim of continuing the axis and allow people to learn from the existing Ecologies on the Green Belt.



Figure 5.9 - Guembé Biocenter.



Figure 5.10 - Cabanas del Río Pirai is a weekend destination where people can enjoy the local food, horse bike riding and motorbikes.



Figure 5.11 - Parque de la Juventud (Park of Youth) is the most skating infrastructures.



Figure 5.12 - Universidad Autónoma Gabriel Rene Moreno (UAGRM) is the largest public university in the city.



Figure 5.13 - Municipal Library is the only public library in Santa Cruz.

PROGRAM

The program should not only adress the ed-ucational expansion to the site, but should also refer to the presence of water and the ecology surrounding it. Throughout the city, water has become a major challenge in terms of accesibility, cleaniless, and man-agement. The intervention should adress these issues by creating an infrastructural netwotk in which organization, communica-tion, education, training and maintenance are stressed.



An Ecomuseum would be a program that encompasses the activities mentioned above. It allows people to understand the evolution of the place while learning about the existing ecologies and the cleaning sys-tems incorporated on them.

An ecomuseum is a museum focused on the identity of a place, largely based on lo-cal participation and aiming to enhance the welfare and development of local communi-ties. It is a dynamic way in which communi-ties preserve, interpret, and manage their heritage for a sustainable development.

An Ecomuseum is an expression of man and nature. It situates man in his natural envi-ronment.

It portrays nature in its wildness, but also as adapted by traditional and industrial society in their own image. It is a conservation centre, in so far as it helps to preserve and develop the natural and cultural heritage of the population. It is a school, in so far as it involves the popula-tion in its work of study and protection and encourages it to have a clearer grasp of its own future.²⁵

Components of the Program:

-  Research
 - Laboratories
 - Training
 - Ecological Conservation
 - Ecological Documentation
 - Wetlands
-  Museum
 - Exhibition Space
 - Auditorium
 - Administration/Offices
 - Cafe
 - Gift Store
-  Entertainment
 - Botanical Garden

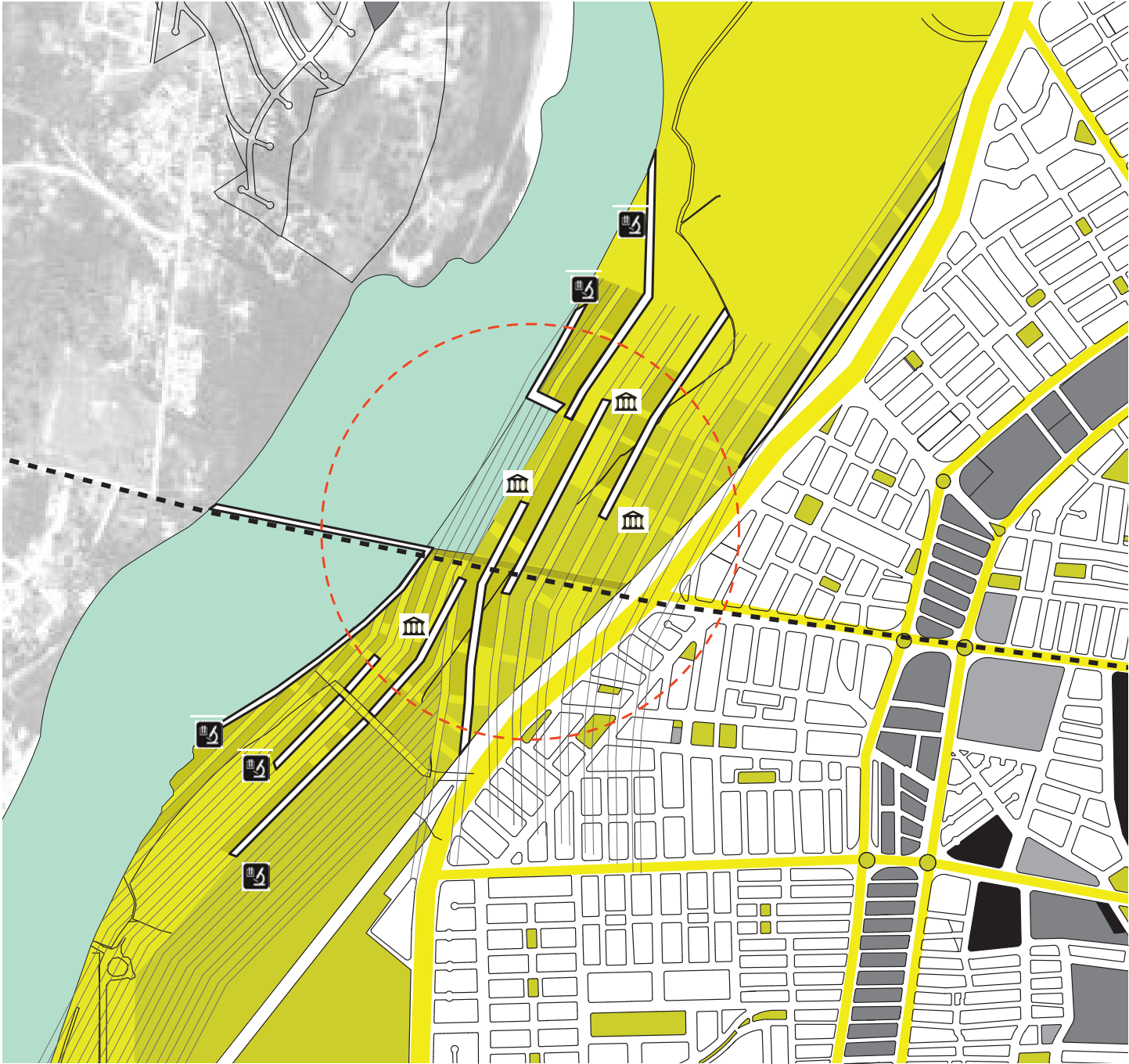


Figure 5.15- Site Plan with Program

25. Riviere Georges Henri, "Images of the Ecomuseum" (1985)

WATER FLOODS

During flood the water becomes part of the experience of the site. The decomposition of the dike as a barrier into series of walls not only brings program to the water edge, promoting the inhabitation of it; but also allows room for flooding. During flood, the skin of the buildings performs as filters that purify the water. This way the interaction between infrastructure and water is not only experiential, but also functional.

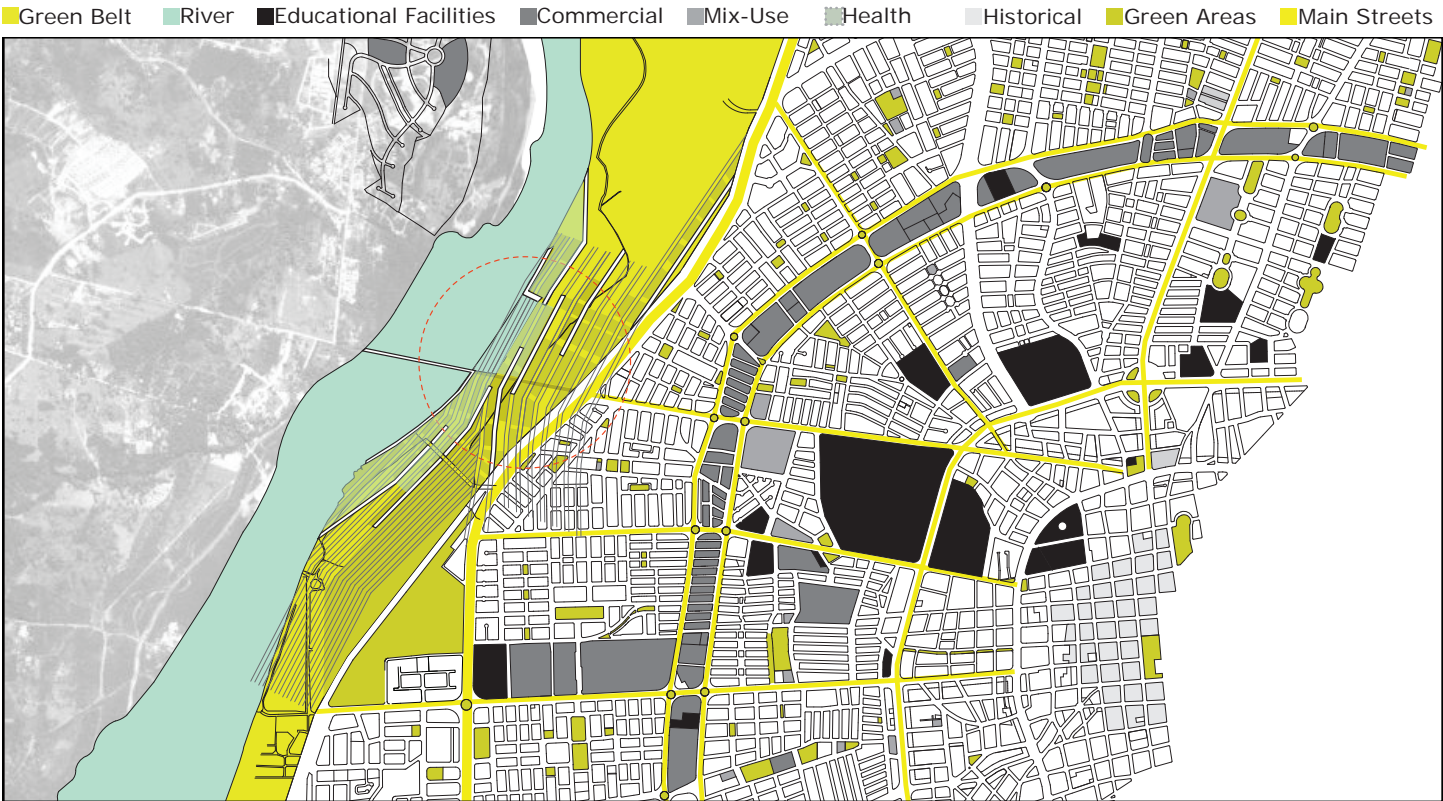
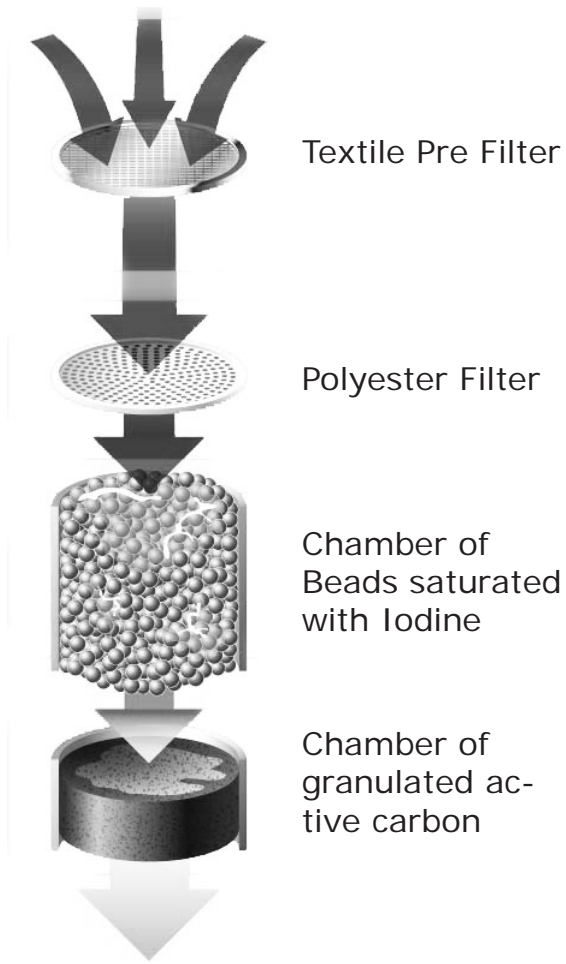


Figure 5.16 - Proposed Site Plan.

HOW CAN IT BE MANIFESTED SPATIALLY?

The Proposal would operate as series of walls that fight flood and host program. By creating a promenade to the river edge, the program would enhance the inhabitation of the river edge as part of the city's daily experience. This way the Green Belt would have an active role on to the daily activities of the city without compromising its ecological function.

The thinness of the walls allows minimum footprint. Densification would increase without causing major deforestation on the site. Also, the skin acts as a water filter when flood occurs. This way, flooding would become an opportunity rather than a threat.



Figure 5.17 - Spatial manifestation of the walls on the landscape



Figure 5.18 - Experience of the walls create a connection between interior and exterior spaces that improve the ecologies and the experience of the site.

“Maybe it’s time to abandon our romantic ideals about the countryside and embrace what science and innovation can offer our cities. If things look or feel like nature, we tend to think that they are also ecological and good. That is why the term ‘natural’ is so widely used in marketing today, even though it is almost meaningless. And there is also a tendency in architecture to imitate it.”

Winy Maas

BIBLIOGRAPHY

IMAGE CREDIT

0. INTRODUCTION

Figure 0.1
Cedric Price, "Three Eggs Diagram", *The Landscape Urbanism Reader* (New York: Princeton Architectural Press, 2006), 55-68.

1. LANDSCAPE + URBANISM

Figure 1.1
Alberto Francini, "PGT Plan for Milan", *Landscape Urbanism Lecture @MOCA* (Kent State University)

Figure 1.2
"Affordable Housing Institute : US." AHI: United States » Just Looking for a Home, Lord, Lord: Part 1, Come All the Way.

Figure 1.3
Benfield Kaid, "An Open Letter to the next President on Sustainable Development (part 2) (reposted)."

2. SANTA CRUZ, BOLIVIA

Figure 2
"Jodanga Backpackers - Santa Cruz de la Sierra, Bolivia." Jodanga Backpackers - Santa Cruz de la Sierra, Bolivia. <<http://jodanga-backpackers-bolivia.minihostels.com/page/santacruz>>.

Figure 2.2
"Travel to South America." Santa Cruz. N.p., n.d. Web. 29 Nov. 2012. <<http://www.south-america-travel.info/bolivia/santa-cruz.html>>.

Figure 2.3
"Jodanga Backpackers - Santa Cruz de la Sierra, Bolivia." Jodanga Backpackers - Santa Cruz de la Sierra, Bolivia. <<http://jodanga-backpackers-bolivia.minihostels.com/page/santacruz>>.

Figure 2.4
Richard Osinaga,"El Cristo, 1983". Web. 30 Oct.2012. <<http://www.historiacamba.com/galeria-camba/>>

Figure 2.5
"Mi Santa Cruz de la Sierra..."la flor dorada de luz"... - Diario de Viaje | Viajeros.com." <<http://www.viajeros.com/diarios/santa-cruz-de-la-sierra/ml-santa-cruz-de-la-sierra-la-flor-dorada-de-luz>>.

Figure 2.7
Samuel Grageda, "La Madre India". 20 December 2010.

Figure 2.8
"Hallan una pista de aterrizaje en el Cordon Ecologico" El Sistema - Elsistema.info. N.p., n.d. Web. 29 Nov. 2012. <<http://elsistema.info/index.php?cat=1>>.

Figure 2.9
Richard Osinaga,"Santa Cruz de la Sierra en 1950". Web. 30 Oct.2012. <<http://www.historiacamba.com/galeria-camba/>>

Figure 2.10
Richard Osinaga,"1966". Web. 30 Oct.2012. <<http://www.historiacamba.com/galeria-camba/>>

Figure 2.11
Richard Osinaga,"1970, Plaza 24 de Septiembre". Web. 30 Oct.2012. <<http://www.historiacamba.com/galeria-camba/>>

Figure 2.12
Richard Osinaga,"1986, Plaza 24 de Septiembre". Web. 30 Oct.2012. <<http://www.historiacamba.com/galeria-camba/>>

Figure 2.13
Richard Osinaga,"Santa Cruz, Equipetrol, 1994". Web. 30 Oct.2012. <<http://www.historiacamba.com/galeria-camba/>>

Figure 2.14
Richard Osinaga,"Santa Cruz 2002". Web. 30 Oct.2012. <<http://www.historiacamba.com/galeria-camba/>>

Figure 2.15
Richard Osinaga,"Santa Cruz se va para arriba 2010". Web. 30 Oct.2012. <<http://www.historiacamba.com/galeria-camba/>>

Figure 2.16
"Viceministro Perez Informa Que Se Levanta El Bloqueo En La Via Cochabamba Santa Cruz." ANF. <<http://www.noticiasfides.com/g/sociedad/viceministro-perez-informa-que-se-levanto-el-bloqueo-en-la-via-cochabamba-santa-cruz-7148/>>.

Figure 2.18
"Canaveral" As Plantas Medicinails Canadeacar Saccharum Officinarum.

Figure 2.20
Adolfo Mendoza Leigue,"Preparan Proyectos de Ley en beneficio del departamento de Santa Cruz." 2011.

Figure 2.22
"Aumenta a 12.300 El Número De Familias Afectadas Por Las Lluvias En Bolivia | AVN." <<http://www.avn.info.ve/contenido/aumenta-12300-n%C3%BAmero-familias-afectadas-lluvias-bolivia>>.

Figure 2.24
Searpi. "Cuenca Hidrografica del Rio Pirai" (May,29,2012) Searpi. "Cuenca Hidrografica del Rio Pirai"

Figure 2.26
Kenner, Dario. "Bolivia Diary." <<http://boliviadiary.wordpress.com/2012/04/22/interviews-in-the-bolivian-chaco-indigenous-peoples-and-natural-resources/>>.

Figure 2.28
Andre, Christopher. "El Boom De La Construcción genera 50 Mil Nuevos Empleos." <http://www.radiofides.com/noticia/economia/El_boom_de_la_construccion_genero_50_mil_nuevos_empleos>.

Figure 2.30
Searpi. "Deforestación en la Cuenca Hidrográfica del Río Pirai" (May,29,2012) Searpi. "Cuenca Hidrográfica del Río Pirai"

Figure 2.31
Martín Fernández de Córdova, "Santa Cruz De La Sierra, Bolivia." Wordpress, 29 Sept. 2012. Web. 11 Oct. 2012. <<http://martinfdc.wordpress.com/>>

Figure 2.32
Andre, Christopher. "El Boom De La Construcción genera 50 Mil Nuevos Empleos." <http://www.radiofides.com/noticia/economia/El_boom_de_la_construccion_genero_50_mil_nuevos_empleos>.

3. PIRAI RIVER

Figure 3.1
Julio Aracil, "Santa Cruz 004". Oct.4 2008.

Figure 3.2
"La Alcaldía Anuncia Intervenir Agua Pluviales." Diario El Día Bolivia. N.p., 28 June 2011. Web. . <<http://www.eldia.com.bo/index.php?cat=362>>.

Figure 3.3
El Deber, "Desague", El Diario el Deber, 01 May 2011.

Figure 3.4
Julico. "Cabanías Del Río Pirai." WikiGOGO. N.p., n.d. Web. 29 Nov. 2012. <<http://wikigogo.org/ru/127494/>>.

Figure 3.5
Julico. "Cabanías Del Río Pirai." WikiGOGO. N.p., n.d. Web. 29 Nov. 2012. <<http://wikigogo.org/ru/127494/>>.

Figure 3.6
Julico. "Dike." WikiGOGO. N.p., n.d. Web. 29 Nov. 2012. <<http://wikigogo.org/ru/127494/>>.

4. RE-THINKING THE GREEN BELT

Figure 4.2
Juliet Davis, "Development Patterns", *Sustain and Develop* (New York: Princeton Architectural Press, 2009), 43.

Figure 4.3
Juliet Davis, "Development Patterns", *Sustain and Develop* (New York: Princeton Architectural Press, 2009), 43.

Figure 4.20
Tyler Caine, Luke Carnahan, Ryan Doyle. and Brandon Specketer. "Gowanus Canal Competition". 2011.

Figure 4.21
Tyler Caine, Luke Carnahan, Ryan Doyle. and Brandon Specketer. "Gowanus Canal Competition". 2011.

Figure 4.26
Tyler Caine, Luke Carnahan, Ryan Doyle. and Brandon Specketer. "Gowanus Canal Competition". 2011.

Figure 4.27
"Torre De Belem, Belem Tower." Torre De Belem, Lisbon. <http://www.lisbonweekendguild.com/lisbon-sights/tower_Torre_Belem.html>.

Figure 4.28
"Torre De Belem, Belem Tower." Torre De Belem, Lisbon. <http://www.lisbonweekendguild.com/lisbon-sights/tower_Torre_Belem.html>.

Figure 4.29
Gino Banegas, "Theater of Marcellus and the Timberl Islandr." Types of Roman Theaters.

5. PROPOSAL

Figure 5.1
Carmela Delgado, "Puente Bicentenario Urubó". 2012 <<http://www.eldeber.com.bo>>.

Figure 5.3
Igor Ruiz Celada, "Panorama". 2012 <<http://www.eldeber.com.bo>>.

Figure 5.4
Igor Ruiz Celada, "Panorama". 2012 <<http://www.eldeber.com.bo>>.

Figure 5.9
"Biocentro Guembe, Mariposario - Resort. Misional Tours - Santa Cruz." <<http://santacruzcity.olx.com.bo/biocentro-guembe-mariposario-resort-misional-tours-iid-290842913>>.

Figure 5.10
Lubomir Endara Sanchez, "Las Cabanas del Pirai ya son patrimonio Cultural", 2012. <<http://www.eldeber.com.bo>>.

Figure 5.11
"Parque Autonomico Ex Parque De La Juventud | Facebook." Parque Autonomico Ex Parque De La Juventud | Facebook. <<http://www.facebook.com/photo.php?fbid=130991796935083>>.

Figure 5.112Lincoln Quevedo "Universidad Autonoma Gabriel Rene Moreno". <<http://www.panoramio.com>>.

Figure 5.13
Gino Banegas, "Biblioteca Municipal - Plazuela del Estudiante". <<http://www.panoramio.com>>.

Figure 5.17 and 5.18
Author using precedent "Zeem House" by Polifactory.

BIBLIOGRAPHY

Allen, Stan, "Landform Building: Architecture's New Terrain [Hardcover]." Landform Building: Architecture's New Terrain, 250-264.

Angelil Marc, and Hebel Dirk . "Cities of Change Addis Ababa. Transformation strategies for urban territories in the 21st Century." Berlin: Birkhauser Verlag AG, 2010.

Davis, Juliet, "Sustain and Develop", (New York: Princeton Architectural Press, 2009), 35-43.

Fernandez de Cordova, Martin. "Santa Cruz De La Sierra, Bolivia." Martin Fernandez De Cordova. Wordpress, 29 Sept. 2012. Web. 11 Oct. 2012. <<http://martinfdc.wordpress.com/>

Gandarilla Suarez, Remberto. "Santa Cruz en los Umbrales del Desarrollo" (1995)

Graham Shane,"The Emergence of Landscape"The Landscape Urbanism Reader(New York: Princeton Architectural Press, 2006), 55-68

Maas, Winy, Hackauf, Ulf , and Haikola, Pirjo "Green Dream". Amsterdam: NAI Publishers, 2010.

Marinkovic, Vesna. "Jornada Del Censo De Poblacion y Vivienda 2012." Diario El Dia Bolivia. N.p., 26 Sept. 2012. Web. 20 Nov. 2012. <<http://www.eldia.com.bo/index.php?cat=162>>.

Mauricio Florencio, Villazon, Aranibar Christian Roy, and Patrick Willems. "Hydrodynamics Unsteady Flow Model Applied to Pirai River for Flood Events Estimation in Santa Cruz, Bolivia." N.p., Aug. 2009. Web. 27 Nov. 2012. <http://apo.sdsu.edu/5802technical_reports.html>.

Riviere, Georges Henri, "Images of the Ecomuseum" .Paris: Unesco. Vol 37. (1985)

Santa Cruz, Bolivia. Bolivia Bella. www.boliviabella.com, n.d. Web. 10 Oct. 2012. <<http://www.boliviabella.com/santa-cruz.html>>.

Searpi. "Cuenca Hidrografica del Rio Pirai" (May,29,2012) Searpi. "Cuenca Hidrografica del Rio Pirai" (May,29,2012)

Shanon, Kelly,"From Theory to Resistance: Lanscape Urbanism in Europe", The Landscape Urbanism Reader, (New York: Princeton Architectural Press, 2006), 141-161.

Sitko Nicki ."Urban Growth Boundaries: Economic Development Tool or unwanted Interference?" (April,21, 2005), 1-7.

Tilder, Lisa, and Blostein, Beth. Design Ecologies. Essays on the Nature of Design. New York: Princeton Architectural Press.

Tyler, Caine, Carnahan Luke, and Specketer Brandon. "Gowanus Lowline Competition Winners." Archinect. www.archinet.com, n.d. Web. 21 Nov. 2012. <<http://archinect.com/news/gallery/15432094/1/gowanus-lowline-competition-winners>>.

Waldheim, Charles. Landscape as Urbanism. New York: Princeton Architectural Press, 2006.

Warren, Patrizio. "Ordenamiento Territorial Municipal: Una Experiencia En El Departamento De Santa Cruz, Bolivia." N.p., 2000. Web. Sept. 2012.